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- ☐ Fee Transmittal Form
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- ☐ Amendment/Reply
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  - ☐ Affidavits/declaration(s)
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- ☐ After Allowance Communication to TC
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- ☒ **Appeal Communication to TC** (*Appeal Notice, Brief, Reply Brief*)

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In the Application of:

Silva-Craig et al.

Application No.: 09/681,471

Filed: April 13, 2001

For: Application Service Provider Based Redundant Archive Services for Medical Archives and/or Imaging Systems

Examiner: Baoquoc N. To

Group Art Unit: 2172

Attorney Docket No.: 15-IS-5715

CERTIFICATION UNDER 37 C.F.R. §§ 1.08, 1.10

I hereby certify that this document is being deposited with the United States Postal Service on August 4, 2005, in an envelope addressed to the Mail Stop Appeal Brief- Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, utilizing the "Express Mail Post Office to Addressee" service of the United States Postal Service under Mailing Label No. EV640750865US.

Christopher R. Carroll

Christopher R. Carroll

BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an Appeal from an Office Action dated September 22, 2004, in which claims 1-8, 11-20, 23-36 and 53-54 were finally rejected. An Advisory Action dated February 9, 2005 maintained these rejections and did not enter an Amendment dated November 22, 2004.

This Appeal Brief is re-submitted in support of the Notice of Appeal filed on February 22, 2005 and in response to the Notification of Non-Compliant Appeal Brief mailed July 28, 2005. This Brief is submitted within one month or thirty days from the mailing date of the Notification of Non-Compliant Appeal Brief mailed July 28, 2005. The Applicant respectfully requests that the Board of Patent Appeals and Interferences reverse the final rejection of claims 1-8, 11-20, 23-24, 30, 35-36 and 53-54 of the present application.

REAL PARTY IN INTEREST

GE Medical Systems Information Technologies, Inc., a Wisconsin corporation having a place of business at 8200 West Tower Avenue, Milwaukee, Wisconsin 53223-3293, owns the entire right, title and interest in and to the invention, the application, and any and all patents to be obtained therefor, as set forth in the Assignment filed with the present application and recorded on Reel 011920, frame 0327. General Electric Company, a corporation organized under the laws of the state of New York, and having a place of business at 1 River Road, Schenectady, New York 12345, owns 100% of GE Medical Systems Information Technologies, Inc.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences currently pending.

STATUS OF THE CLAIMS

Claims 1-8, 11-20, 23-36 and 53-54 are pending in the present application. Pending claims 1-8, 11-20, 23-24, 30, 35-36 and 53-54 have been rejected under 35 U.S.C. § 103(a) and are the subject of this appeal. Specifically, claims 1-5, 7-8 and 11-14 have been finally rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,678,703 to Rothschild et al. ("Rothschild").[1] Claim 6 has been finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Rothschild in view of U.S. Patent No. 6,675,271 to Xu et al. ("Xu").[2] Claims 15-20, 24-34 and 53-54 have been finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Rothschild in view of U.S. Patent No. 6,678,764 to Parvulescu et al. ("Parvulescu").[3] Claims 23 and 35-36 have been finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Rothschild in view of Parvulescu and further in view of Xu.[4]

STATUS OF AMENDMENTS

Subsequent to the final rejection of claims 1-8, 11-20, 23-36 and 53-54 in the Office Action mailed September 22, 2004, proposed amendments to claims 1, 15 and 25 were included in an Amendment filed November 22, 2004. The proposed amendments to

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[1] Final Office Action of Sept. 22, 2004 at page 2 (*see* Evidence Appendix to the present Appeal Brief).
[2] Final Office Action of Sept. 22, 2004 at page 5.
[3] Final Office Action of Sept. 22, 2004 at page 5.
[4] Final Office Action of Sept. 22, 2004 at page 10.

claims 1, 15 and 25 were not entered by the Examiner, as stated in the Advisory Action mailed February 9, 2005.

SUMMARY OF CLAIMED SUBJECT MATTER

The following is a concise explanation of the subject matter defined in each of the independent claims involved in this appeal, namely independent claims 1, 15, and 25.

The present invention relates to an Application Service Provider ("ASP") based redundant archive services for medical archives and/or imaging systems. Healthcare practitioners employ medical data for the diagnosis and treatment of patients.[5] This medical data can include medical images, reports, applications and other data and may be obtained from direct examination of a patient, from other healthcare practitioners, from medical diagnostic equipment, and/or other sources.[6]

Medical data may be stored in a computer database such as a Picture Archiving and Communication System ("PACS").[7] A PACS system can be used to obtain, store, and distribute medical data, to archive medical data in electronic form in a central location, to share medical data among several users, for example.[8] With the increasing use of PACS systems in the diagnosis and treatment of patients, there is increased need for greater backup and redundancy storage capabilities for medical data. In addition,

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[5] Specification of Pending Application Serial No. 09/681,471 at page 1, lines 5-11 (herein referred to as "'471 Specification").
[6] '471 Specification at page 1, lines 5-11.
[7] '471 Specification at page 1, lines 12-18.
[8] '471 Specification at page 2, lines 1-8.

centralized access to medical data can also improve diagnosis and treatment of patients through the ease of retrieval by multiple users and/or multiple locations. Also, diagnosis and/or treatment of a patient may be impaired if the data becomes lost or corrupted. Thus, a need exists for reliability in the storage of medical data to improve diagnosis and treatment of patients.

There is also a need for easier data manipulation and/or preservation between medical diagnostic system upgrades. For example, there is a need for a system to reduce manual transfer and/or re-creation of data, applications, and/or operating system information between an old medical diagnostic or storage system and a new or replacement system.

The present invention provides a centralized remote data storage and retrieval system comprising a data source (reference number 110 in Figure 1), a remote data store (reference number 120 in Figure 1), a front-end connection (reference number 130 in Figure 1), a back-end connection (reference number 135 in Figure 1), a status monitor (reference number 140 in Figure 1) and an access authenticator (reference number 145 in Figure 1).[9] The data source (reference number 110 in Figure 1) provides medical data, the status monitor (reference number 140 in Figure 1) controls the transfer of the medical data from the data source (reference number 110 in Figure 1) to the remote data store (reference number 120 in Figure 1), and the remote data store (reference number 120 in

[9] '471 Specification at page 6, lines 1-6.

Figure 1) receives and stores the medical data.[10] The access authenticator (reference number 145 in Figure 1) authenticates access of the remote data store (reference number 120 in Figure 1) by the data source (reference number 110 in Figure 1) and/or access of the data store (reference number 110 in Figure 1) by the remote data store (reference number 120 in Figure 1) in order to copy, transfer or restore medical data.[11]

The data source (reference number 110 in Figure 1) is a source or point of origin of medical data and may include a picture archiving and communications system (PACS), a medical diagnostic imaging system, a database system, a computer system, a server, a hard disk drive, a terminal, or other medical data storage system, for example.[12]

The remote data store (reference number 120 in Figure 1) is a device that archives or stores medical data, such as an application service provider, a server, a redundant disk array, a Redundant Array of Independent Disks ("RAID") drive, a hard disk drive, an archive, a database system, a computer system, or other central data storage system, for example.[13]

The front- and back-end connections (reference numbers 130 and 135 in Figure 1) facilitate the bi-directional transmission and/or reception of files, commands, instructions, communication information, and/or other data, for example, between (1) the data source and the status monitor (and access authenticator) and (2) the status monitor (and access

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[10] '471 Specification at page 6, lines 1-6.
[11] '471 Specification at page 8, lines 18-31.
[12] '471 Specification at page 6, lines 15-23.
[13] '471 Specification at page 7, lines 1-16.

authenticator) and the remote data store.[14] The front-end connection and the back-end connection may compose a data source/data store connection to transfer data between the data source and the remote data store.[15]

The status monitor monitors the data source, the remote data store, the front-end connection, and/or the back-end connection.[16] The status monitor monitors and/or controls activities such as:

- requests by the data source and/or remote data store,
- data at the data source and/or remote data store,
- data traveling over the front-end connection and/or the back-end connection, and/or
- commands and/or instructions traveling over the front-end connection and/or the back-end connection, for example.

The present invention provides for three types of medical data archiving actions or steps to be performed. Specifically, the present invention provides for (1) the **archiving** of medical data obtained at the data source at the remote data store, (2) the **restoring** of archived medical data from the remote data store to the data source, and (3) the **copying** of medical data originally obtained at a first data source (and archived at the remote data store) to a second data source.[17]

The subject matter defined in independent claims 1 and 25 relates to a system (claim 1) and a method (claim 25) for the archiving of medical data. For the archiving of

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[14] '471 Specification at page 7, lines 17-32 and page 8, lines 1-3.
[15] '471 Specification at page 7, lines 28-32 and page 8, lines 1-3.
[16] '471 Specification at page 8, lines 4-17.

medical data, the data is first obtained using the data source.[18] The data source may then locally store a copy of the medical data.[19] Next, the status monitor may prompt the data source for an authentication code.[20] If the access authenticator determines that the authentication code matches a predetermined authentication code, then the status monitor triggers an archive request to be sent to the remote data store and instructs the data source to transmit the medical data to the remote data store.[21] Once the data source transmits the medical data to the remote data store, the medical data has been archived. In this way, medical data obtained by a data source is archived so as to provide a back-up in case the data stored at the data source becomes corrupted, lost, or otherwise unreadable.

The subject matter defined in independent claim 15 relates to a system for the restoring of medical data and/or the copying of medical data. For the restoring of medical data, the data is first obtained at the data source and archived at the remote data store, as described above in regard to the archiving of medical data.[22] Next, an error in the medical data, such as data loss, data corruption, and/or system failure, is discovered.[23] The status monitor may then prompt the data source for an authentication code.[24] If the access authenticator determines that the authentication code matches a predetermined authentication code, then the status monitor triggers a restore request to be sent to the

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[17] '471 Specification at page 9, lines 14-29.
[18] '471 Specification at page 9, lines 14-29.
[19] '471 Specification at page 9, lines 14-29.
[20] '471 Specification at page 10, lines 1-18.
[21] '471 Specification at page 10, lines 1-28 and page 11, lines 1-9.
[22] '471 Specification at page 11, lines 26-31.
[23] '471 Specification at page 12, lines 1-7.

remote data store and instructs the remote data store to restore the medical data to the data source.[25] Once the remote data store transfers the medical data to the data source, the data has been restored. In this way, an error in the medical data is repaired by restoring the erroneous data with non-erroneous data archived at the remote data store.

For the copying of medical data, the data is first obtained at the data source and archived at the remote data store, as described above in regard to the archiving of medical data.[26] Next, the status monitor may detect a need to copy archived medical data to another data source.[27] For example, medical data may be obtained on a first data source. A second data source, such as a new, upgraded or replacement data source may then be installed.[28] In order to ensure that the same medical data stored at the first data source is also stored at the second data source, the medical data previously obtained using the first data source and archived at the remote data store may be copied from the remote data store to the second data source.

Once the status monitor detects a need to copy medical data to a second data source, the status monitor may then prompt the data source for an authentication code.[29] If the access authenticator determines that the authentication code matches a predetermined authentication code, then the status monitor triggers a copy request to be sent to the remote data store and instructs the remote data store to copy the medical data

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[24] '471 Specification at page 12, lines 8-23.
[25] '471 Specification at page 12, lines 8-32 and page 13, lines 1-10.
[26] '471 Specification at page 13, lines 20-26.
[27] '471 Specification at page 13, lines 20-26.
[28] '471 Specification at page 13, lines 27-31 and page 14, lines 1-13.

to the second data source.[30] Once the remote data store transfers the medical data to the second data source, the data has been copied. In this way, medical data obtained at one or more data sources and archived at the remote data store, may be copied to one or more additional data sources.

Thus, the subject matter defined in independent claims 1, 15 and 25 relate to systems and methods for the archiving, restoring and copying of medical data in a PACS system in order to protect against the loss or corruption of data and for easier copying of medical data among data sources.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection presented for review on appeal are:

(1) The rejection of claims 1-2, 5, 7, and 11-14 under 35 U.S.C. § 103(a) (2005) in view of Rothschild.

(2) The rejection of claims 3 and 4 under 35 U.S.C. § 103(a) in view of Rothschild.

(3) The rejection of claim 19 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.

(4) The rejection of claim 30 under 35 U.S.C. § 103(a) in view of Rotshchild and further in view of Parvulescu.

(5) The rejection of claim 6 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Xu.

(6) The rejection of claim 23 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu and Xu.

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[29] '471 Specification at page 13, lines 27-31 and page 14, lines 1-13.
[30] '471 Specification at page 14, lines 14-32.

(7) The rejection of claim 35 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu and Xu.

(8) The rejection of claim 8 under 35 U.S.C. § 103(a) in view of Rothschild.

(9) The rejection of claims 15-18, 20, 24 and 54 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.

(10) The rejection of claim 36 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu and Xu.

(11) The rejection of claim 53 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.

ARGUMENT

In order to more clearly set forth the patentable differences between the various groups of claims listed above and the references cited by the Examiner in each of his rejections, the Applicant has grouped the claims according to common patentable limitations appearing in each claim. The Applicant respectfully submits that claims 1-8, 11-20, 23-24, 30, 35-36 and 53-54 are distinguishable over the prior art.

I. The Law Of Obviousness Under 35 U.S.C. § 103(a)

The Examiner has rejected all pending claims under 35 U.S.C. § 103(a), which states:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at

> the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.[31]

There are "three basic criteria" for "a *prima facie* case of obviousness."

> To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.[32]

The Final Office Action of September 22, 2004 violates the last of the three basic legal criteria set out above for establishing a *prima facie* case, which is: "**all** the claim limitations must be taught or suggested by the prior art."[33]

In ascertaining the differences between the prior art and the claims of a pending application under 35 U.S.C. § 103(a), the analysis "is not whether the differences **themselves** would have been obvious, but whether the claimed invention **as a whole** would have been obvious."[34] Moreover, "[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art."[35] As described in detail

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[31] 35 U.S.C. § 103(a).
[32] MANUAL OF PATENT EXAMINING PROCEDURE § 2142 (8th ed., rev. 2, May 2004) at 128 (citing *In re Vaeck*, 947 F.2d. 488 (Fed. Cir. 1991)) (hereinafter cited at "MPEP").
[33] MPEP § 2143.03 at 133 (citing *In re Royka*, 490 F.2d 981 (C.C.P.A. 1974)) (emphasis added).
[34] MPEP § 2141.02 at 124-125 (citing *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530 (Fed. Cir. 1983)).
[35] MPEP § 2143.03 at 133 (quoting *In re Wilson*, 424 F.2d 1382, 1385 (C.C.P.A. 1970)).

below, none of the references cited by the Examiner teach or suggest all limitations of the appealed claims.

A critical step in analyzing the patentability of claims pursuant to § 103(a) is casting the mind back to the time of invention, to properly consider the thinking of one of ordinary skill in the art, guided only by the prior art references and the then-accepted wisdom in the field.[36] The proper obviousness analysis under 35 U.S.C. § 103(a) must occur at the time the invention was made and avoid the impermissible use of hindsight:

> To reach a proper determination under 35 U.S.C. 103, the examiner must step backward in time and into the shoes worn by the hypothetical "person of ordinary skill in the art" when the invention was unknown and just before it was made. In view of all factual information, the examiner must then make a determination whether the claimed invention would have been obvious at that time to that person. . . . The tendency to resort to "hindsight" based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art.[37]

In applying a reference under 35 U.S.C. § 103(a), the "reference must be considered in its entirety, i.e., as a **whole**, including portions that would lead away from the claimed invention."[38] In other words, the cited prior art as a whole must be considered, taking into account the negative teachings that would lead a person of

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[36] *In re Kotzab*, 217 F.3d 1365, 1369 (Fed. Cir. 2000); *see also In re Dembiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999); *Grain Processing Corp. v. Am. Maize-Prods. Co.*, 840 F.2d 902, 907 (Fed. Cir. 1988) (cautioning against employing hindsight by using the appellant's disclosure as a blueprint to reconstruct the claimed invention from the isolated teachings of the prior art).
[37] MPEP § 2142 at 128.
[38] MPEP § 2141.02 at 127 (citing *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540 (Fed. Cir. 1983)).

ordinary skill away from the patented invention, as well as the teachings unfavorable to patentability.[39] The Federal Circuit held in the *Dow* case:

> In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for **the person of ordinary skill is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention**. The Commissioner argues that since the PTO is no longer relying on Farmer or the Bacon and Farmer article, the applicant is creating a "straw man". It is indeed pertinent that these references teach against the present invention. Evidence that supports, rather than negates, patentability must be fairly considered.[40]

Moreover, the law gives significant weight to the fact that the only prior art on point teaches away from limitations of a pending claim.[41]

Finally, as a dependent claim includes all the limitations of the base claim(s) from which it depends, "[i]f an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious."[42] In other words, if an independent claim is nonobvious, then all claims depending on the independent claim are also nonobvious.

The Applicant now presents arguments in favor of the patentability of pending claims 1-8, 11-20, 23-24, 30, 35-36 and 53-54.

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[39] *In re Dow Chemical Co.*, 837 F.2d 469, 473 (Fed. Cir. 1988).
[40] *Id.* (emphasis added).
[41] *See Ecolochem, Inc. v. S. Cal. Edison Co.*, 227 F.3d 1361, 1374 (Fed. Cir. 2000) ("The absence of a convincing discussion of the specific sources of the motivation to combine the prior art references, particularly in light of the strength of prior art teaching away from the use of the Houghton process, is a critical omission in the district court's obviousness analysis, which mainly discusses the ways that the multiple prior art references can be combined to read on the claimed invention.").
[42] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).

II. The Rejection Of Claims 1-2, 5, 7 And 11-14 Under 35 U.S.C. § 103(a) In View Of Rothschild

In the Final Office Action mailed September 22, 2004, the Examiner rejected claims 1-5, 7-8 and 11-14 under 35 U.S.C. § 103(a) in view of Rothschild.[43] Claims 1-2, 5, 7 and 11-14 are discussed together as a group separate from claims 3-4 and 8 because each of claims 3-4 and 8 recite additional patentable limitations, as described below. However, as claims 3-4 and 8 depend from claim 1, if claim 1 is deemed patentable, then claims 3-4 and 8 must also be deemed patentable.

For the sake of simplicity, Applicant has elected to only argue the substantive merits of the patentability of independent claim 1 in this group. If claim 1 is deemed patentable, then claims 2, 5, 7 and 11-14, which depend from claim 1, must also be deemed patentable.[44]

Independent claim 1 recites (with emphasis added):

> 1. A central medical data archiving system, said system comprising:
>
> a medical data source providing medical data, wherein said medical data comprises at least one of a medical image, a medical patient report, and a medical application;
>
> a status monitor for controlling the transfer of said medical data from said data source to a centralized remote data store, **wherein said**

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[43] Final Office Action of Sept. 22, 2004 at 3.

[44] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).

> **status monitor monitors operations** occurring at at least one of said data source and centralized remote data store **and triggers transfer** of said medical data to said centralized remote data store **based on said operations**; and
>
> a centralized remote medical data store receiving said medical data and storing said medical data, wherein said centralized remote medical data store comprises an application service provider.

Rothschild is the foundational reference relied upon by the Examiner in rejecting all claims of the present application. Rothschild is directed to a system and method for managing medical images at a central data management system.[45] Through their invention, Messrs. Rothschild and Prasad have attempted to improve on the distribution of electronic records and medical images. The Rothschild patent describes a medical imaging system, a central data management system, and one or more remote image viewing systems.[46] Within the medical imaging system, medical images of a patient are obtained and transferred to a local image workstation.[47] The local image workstation stores the images locally and then automatically pushes, or transfers, the images from the medical imaging system to the central data management system.[48] Once the images are

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[45] Rothschild at Abstract.
[46] Rothschild at col. 18, line 39 through col. 19, line 4.
[47] Rothschild at col. 18, lines 42-51.
[48] Rothschild at col. 18, lines 53-56.

received at the central data management system, the images are once again stored at that location and are automatically pushed, or transferred, to the remote viewing system(s).[49]

At each instance of transferring the images (once from the imaging system to the central data management system and a second time from the central data management system to the remote viewing system), the images are automatically pushed or transferred from one point to another as soon as possible.[50] In other words, the images are pushed, without any trigger or request, from a first location to a second location as soon as possible. The purpose of this feature of the Rothschild invention is to ensure that images are routed to doctors at remote viewing systems as soon as possible:

> In contrast to other known efforts at providing a medical image management ASP, the present invention employs "push" delivery of medical images directly to the referring physician's office or offices, which may be completed according to the invention **immediately after generating the image at the medical imaging center**. The use of the push methodology directly addresses the needs of referring physicians prescribe [sic] the imaging study in order to diagnose or treat a patient. Clearly, these healthcare providers want the images delivered to their office(s) just as they have the [x-ray] films delivered today. With push delivery of electronic image records according to the invention, the image delivery will take place in the background and be on the physician's desktop computer ready for review whenever the doctor is ready to view them.[51]

Therefore, Rothschild describes a system and method that obtains and transfers images along a routing path (that includes the imaging, data management, and viewing systems), where the images are pushed from one point to another along the path as soon as

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[49] Rothschild at col. 18, lines 63-67.
[50] Rothschild at col. 18. lines 53-56 and lines 63-67.
[51] Rothschild at col. 23, lines 40-54 (emphasis added).

possible. While the images may be locally stored at each point along the routing path, the images are automatically routed, as soon as possible, from one point to another, without waiting for a trigger from any other device, processor, or process. That is, each location in the routing path independently sends the images to the next point in the routing path without waiting for any other device, processor or process to command or instruct the location to transfer the image to the next point in the path.

In rejecting independent claim 1, the Examiner recognizes that Rothschild does not teach a status monitor for controlling the transfer of medical data from a data source to a centralized remote data store.[52] However, the Examiner asserts that Rothschild teaches a medical image center that "track[s] the entire process of image delivery and review from [a] local image workstation (20) merely by reference to the local image workstation (20) located in their [sic] respective clinic or hospital. The medical image center is the status monitor."[53]

While the medical image center of Rothschild may "track the entire process of image deliver storage and review from the local image workstation,"[54] Rothschild does not teach or suggest the medical image center (or any other component of any system taught by Rothschild) **monitoring operations** occurring at a data source and/or a centralized remote data store and then **triggering** the transfer of medical data to the centralized remote data store based on the operations, as recited in claim 1. Instead,

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[52] Final Office Action of Sept. 22, 2004 at 3.
[53] Final Office Action of Sept. 22, 2004 at 3.

Rothschild merely describes the pushing or transferring of medical data from point to point along a routing path as soon as possible.[55] Rothschild does not describe any status monitor (whether a device, processor, or process separate or included in any one of the imaging, data management, and remote viewing systems) that monitors operations occurring at a data source and/or a remote data storage location and then triggers the transfer of the medical data from one system to another. In other words, Rothschild describes a system that merely transmits data as soon as possible, without waiting for any trigger:

> The central data management system (30) [of Rothschild] actively "pushes" the electronic records (5) and associated images (6) to the remote image viewing systems (40) of the radiologists and referring doctors **as soon as the images are available**. . . . Therefore, at each of the locations where the images would be needed, the remote image viewing station (40) would be running and available at all times on the Internet in order to achieve **immediate "push" delivery of the images as soon as they become available**.[56]

Thus, while Rothschild describes the automatic routing of medical data, claim 1 includes a limitation that requires a status monitor to both **monitor operations** (occurring at a data source and/or a centralized remote data store) **and trigger the transfer** of medical data based on the operations. Claim 1 therefore recites at least one limitation not taught by Rothschild.

The Examiner provides no other support for his assertion that pending claim 1 is obvious in view of Rothschild. Each of pending claims 2, 5, 7, and 11-14 depend from

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[54] Rothschild at col. 29, lines 12-14.

claim 1. Therefore, as Rothschild does not teach or suggest elements of pending claim 1, Applicant respectfully submits that the Examiner's rejection of claims 1, 2, 5, 7, and 11-14 under 35 U.S.C. § 103(a) in view of Rothschild should not be allowed to stand.

Moreover, pending claims 3-4, 6 and 8 also depend from claim 1. The Applicant has grouped these pending claims separately from claims 1-2, 5, 7, and 11-14 because each of claims 3-4 and 8 includes additional patentable limitations, as described in more detail below. However, if claim 1 is deemed patentable, then claims 3-4 and 8 must also be deemed patentable.

III. The Rejection Of Claims 3 And 4 Under 35 U.S.C. § 103(a) In View Of Rothschild

In the Final Office Action mailed September 22, 2004, the Examiner rejected claims 3 and 4 under 35 U.S.C. § 103(a) in view of Rothschild.[57] The Applicant has grouped claims 3 and 4 together because each of these claims includes an additional limitation relating to authenticating access to a remote data store (with emphasis added):

> 3. The system of claim 1, further comprising an access authenticator for **authenticating access to said remote data store by said data source**.
>
> 4. The system of claim 3, wherein said access authenticator **authenticates access to said data source**.

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[55] Rothschild at col. 18, lines 48-67.
[56] Rothschild at col. 22, lines 25-38 (emphasis added).
[57] Final Office Action of Sept. 22, 2004 at 2.

For the sake of simplicity, the Applicant will only argue the substantive merits of claim 3. Claim 4 depends from claim 3. Therefore, if claim 3 is deemed patentable, then claim 4 must also be deemed patentable.[58] The Applicant respectfully submits that Rothschild also does not teach or suggest authenticating access to a remote data store. Therefore, the Applicant submits that claims 3 and 4 stand or fall together and are patentable under 35 U.S.C. § 103(a) in view of Rothschild.

The access authenticator of the pending claims is employed to permit or deny access to a remote data store.[59] If access is granted, the access authenticator permits medical data to be archived, restored, or copied, as described above in the Summary Of The Invention section of this Brief.[60]

With regard to claim 3, the Examiner asserts, "Rothschild teaches an access authenticator for authenticating access to said remote data store by said data source (login)."[61] Contrary to the Examiner's assertions, however, Rothschild does not teach or suggest any access authenticator for authenticating access to a remote data store. In fact, Rothschild explicitly teaches away from authenticating any access to a remote data store by repeatedly criticizing the authentication required by other systems and methods to deliver medical images:[62]

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[58] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[59] *See, e.g.*, '471 Specification at page 8, lines 18-31.
[60] '471 Specification at page 10, lines 1-18.
[61] Final Office Action of Sept. 22, 2004 at 4.
[62] While Rothschild repeatedly criticizes other systems and methods for requiring authentication before a physician may download or access medical images, the Applicant respectfully submits that Rothschild's criticisms are insufficient to establish that the criticized systems and methods

> In general, most of the known systems and method for managing medical images in electronic record format use "pull" type image delivery protocol which requires the referring physician to log on to a web server and then download his or her patient's images. However, busy physicians do not have the time or the desire to access their patient's images in this manner. The "pull" model requires the physician to log in as well as extensive physician input and time to initiate the data transfer.[63]
>
> All other known medical image management systems and methods are believed to require the physician to log on to web sites and then download the images to his computer. Hence, with other ASP systems not associated with the present invention, if the physician wishes to see his patients' images again, he must repeat the extensive and lengthy login and download procedures. It is believed that such methods which rely upon the physician to actively login and download, will be unacceptable for the referring doctors who are extremely busy and are used to images being delivered to them on film.[64]

Rothschild also clearly states that its invention delivers medical images to doctors and radiologists as soon as the images are available, without requiring any type of authentication before the images are delivered:

> The central data management system (30) actively "pushes" the electronic records (5) and associated images (6) to the remote image viewing systems (40) of the radiologists and referring doctors as soon as the images are available. **This contrasts with the "pull" model where** the images are stored on a server and **a user has to login** and initiate a download in order to view the images.[65]

In other words, Rothschild describes a system and method where medical images are transferred from an image source (Rothschild's medical imaging system) to a central data

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teach or suggest the limitations of claim 3. For example, none of Rothschild's criticisms teach or suggest that prior systems included an access authenticator for authenticating access to a remote data store by a data source (as recited in pending claim 3).

[63] Rothschild at col. 4, lines 42-50.

[64] Rothschild at col. 24, line 60 through col. 25, line 3.

[65] Rothschild at col. 22, lines 25-31 (emphasis added).

management system, then to a remote image viewing system as quickly as possible, with no additional delays introduced by requiring that access to any of the image source, central data management system, and/or remote image viewing system be authenticated.

The only disclosure in Rothschild of any authentication occurs in one embodiment, namely an embodiment that includes a polling system within a remote viewing station.[66] In this embodiment, the polling system automatically polls the central data management system for medical data that is queued for delivery to the remote viewing station.[67] The polling system determines the IP address of the remote viewing station and notifies the central database (assumed to be part of the central data management system) of its current IP address.[68] An IP notifier of the polling system then notifies the central database of the IP address "after proper authentication."[69] In other words, the only authentication disclosed in Rothschild is the authentication of a remote viewing station's current IP address.

This embodiment of Rothschild does not teach or suggest limitations recited by claim 3. First, it is unclear how the "proper authentication" is performed. Rothschild is devoid of any teaching or suggestion of how the IP notifier is properly authenticated. The only disclosure of the IP polling system in Rothschild is located at column 15, line 43 through column 17, line 12 and at column 32, line 40 through column 33, line 55.

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[66] Rothschild at col. 15, lines 54-65.
[67] Rothschild at col. 15, lines 54-65.
[68] Rothschild at col. 15, lines 58-59.
[69] Rothschild at col. 15, lines 58-59.

However, nowhere in these sections is any disclosure, teaching or suggestion of an access authenticator for authenticating access to a remote data store by a data source, as recited in claim 3.

Moreover, assuming for the sake of argument that Rothschild did sufficiently disclose an access authenticator or a step of authenticating access, such a disclosure only describes authenticating access to the central data management system by a remote viewing station in order to provide a current IP address. In other words, assuming *arguendo* that Rothschild does provide such a sufficient disclosure, Rothschild only describes an end-of-the-line, downstream viewing station (used by a physician or radiologist to review a patient's medical images)[70] that provides a central data management system with a current IP address of the viewing station once a polling system in the viewing station has received "proper authentication."[71]

However, this authentication in Rothschild is substantially different from the access authentication of claim 3. The authentication of Rothschild is to ensure that the central database receives IP addresses only from authenticated the remote viewing stations.[72] In contrast, the access authenticator of claim 3 determines whether medical data is archived, restored, or copied from a remote data store to a data source.[73] There is

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[70] Rothschild at col. 24, lines 4-9.
[71] Rothschild at col. 54-64.
[72] Again, assuming *arguendo* that Rothschild's disclosure is sufficient to support any teaching or suggestion of authenticating any sort or type of access.
[73] *See, e.g.,* '471 Specification at page 10, lines 1-18, page 12, lines 8-23, page 13, lines 27-31, and page 14, lines 1-13.

no other teaching or suggestion in Rothschild of authenticating access to a remote data store by a data source.

Therefore, Rothschild fails to teach or suggest elements of claim 3. The only disclosure in Rothschild relating to a type of access authentication is insufficient to teach or suggest the limitations of these claims. Moreover, assuming *arguendo* that the disclosure of Rothschild was sufficient to teach or suggest some type of authenticated access, the authenticated access does not teach or suggest the limitations recited in claim 3. Claim 4 depends from claim 3. Thus, claims 3 and 4 are not obvious under 35 U.S.C. § 103(a) in view of Rothschild.

Moreover, as claims 3 and 4 depend from claim 1, if claim 1 is deemed patentable, then claims 3 and 4 must also be deemed patentable.[74]

Therefore, the Examiner's final rejection of pending claims 3 and 4 under 35 U.S.C. § 103(a) in view of Rothschild should not be allowed to stand.

IV. The Rejection Of Claim 19 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu

In the Final Office Action mailed September 22, 2004, the Examiner rejected claim 19 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.[75] The Applicant has grouped claim 19 by itself because claim 19 depends

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[74] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[75] Final Office Action of Sept. 22, 2004 at page 5.

from claim 15 and includes an additional limitation relating to authenticating access to a remote data store (with emphasis added):

> 19. The system of claim 15, further comprising an access authenticator for **authenticating access to said remote data store**.

While the limitation of claim 19 is similar to the limitations of claims 3, 4 and 30, claim 19 is discussed separately because each of these claims depend from a different independent claim.[76] The Applicant respectfully submits that neither Rothschild nor Parvulescu, alone or in combination, teach or suggest authenticating access to a remote data store. Therefore, the Applicant submits that claim 19 stands or falls by itself and is patentable under 35 U.S.C. § 103(a) in view of Rothschild and Parvulescu.

Moreover, as claim 19 depends from claim 15, if claim 15 is deemed patentable, then claim 19 must also be deemed patentable.[77]

With regard to claim 19, the Examiner asserts, "Rothschild teaches an access authenticator fro [sic] authenticating access to said remote data store (login)."[78] However, as described above, Rothschild does not teach or suggest any access authenticator for authenticating access to a remote data store. Moreover, also as described above, Rothschild explicitly teaches away from authenticating any access to a remote data store by repeatedly criticizing the authentication required by other systems and methods to deliver medical images.

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[76] Specifically, claims 3 and 4 depend from claim 1, claim 19 depends from claim 15, and claim 30 depends from claim 25.
[77] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).

Parvulescu does not remedy the shortcomings of Rothschild described above with regard to claim 19.[79] Specifically, Parvulescu does not teach or suggest any access authenticator for authenticating access to a remote data store, as recited in claim 19.

Parvulescu describes a system and method for archiving medical images.[80] The system and method provide an improved medical image archiving system by allowing images traditionally generated in analog form to be readily converted into digital form.[81] A medical image archiving device receives an analog signal from an image capture device, stores the image in digital form, and outputs the digital image to a media writer and a printer.[82] The digitally-captured images may be centrally stored in a hospital server database so as to provide access to one or more client workstations connected to the same Local Area Network ("LAN") as the hospital server.[83]

However, Parvulescu does not include any teaching or suggestion of authenticating access to a remote data store. The only disclosure in Parvulescu related to any type of selective or limited access to medical image data is limited to following excerpt:

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[78] Final Office Action of Sept. 22, 2004 at page 7.
[79] Moreover, even though Parvulescu was not cited in the Examiner's final rejection of pending claims 3 and 4, Parvulescu is also insufficient to overcome the shortcomings of Rothschild, as described in part III of the Argument section of this Brief.
[80] Parvulescu at Abstract.
[81] Parvulescu at col. 3, lines 19-26.
[82] Parvulescu at col. 4, lines 33-37.
[83] Parvulescu at col. 5, lines 9-17.

> Security software 154, such as that commercially available from Verisign, 1350 Charleston Road, Mountain View, Calif. 94043 or others can be used to control access to the images.[84]

The Applicant respectfully submits that this reference to security software is insufficient to constitute a teaching or suggestion of authenticating access to a remote data store, as recited in claim 19. For example, it is unclear if "security software . . . used to control access to the images" means that only users of a particular type of software have the ability to access the images, or if the security software otherwise blocks access to the medical images. Therefore, as Parvulescu is devoid of any other teaching or suggestion of authenticating access to a remote data store, Parvulescu does not teach or suggest elements of claim 19.[85]

In addition, a combination of Rothschild and Parvulescu also fails to teach or suggest elements of claim 19. As described above, both Rothschild and Parvulescu fail to teach or suggest an access authenticator authenticating access to a remote data store. Therefore, a combination of the two references also fails to teach or suggest limitations of claim 19.

In conclusion, both Rothschild and Parvulescu, taken alone or in combination, fail to teach or suggest limitations of claim 19.[86] Claim 19 was rejected by the Examiner

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[84] Parvulescu at col. 5, lines 40-43.
[85] In addition, as pending claims 3 and 4 recite limitations similar to claim 19, Parvulescu also fails to teach or suggest limitations in claims 3 and 4.
[86] While the Examiner has not rejected claims 3 and 4 under 35 U.S.C. § 103(a) in view of Parvulescu alone or in view of Rothschild and further in view of Parvulescu, as described above, neither Rothschild nor Parvulescu, taken alone or in combination, teach or suggest limitations in claims 3 and 4 as well.

under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu. The Applicant respectfully submits that the Examiner's final rejection of claim 19 should not be allowed to stand.

Moreover, as claim 19 depends from claim 15, if claim 15 is deemed patentable, then claim 19 must also be deemed patentable.[87]

V. The Rejection Of Claim 30 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu

In the Final Office Action mailed September 22, 2004, the Examiner rejected claim 30 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.[88] The Applicant has grouped claim 30 by itself because claim 30 depends from claim 25 and includes an additional limitation relating to authenticating access to a remote data store (with emphasis added):

> 30. The method of claim 25, further comprising the step of **authenticating access to said remote data store.**

The Applicant respectfully submits that neither Rothschild nor Parvulescu, alone or in combination, teach or suggest authenticating access to a remote data store. Therefore, the Applicant submits that claim 30 stands or falls by itself and is patentable under 35 U.S.C. § 103(a) in view of Rothschild and Parvulescu.

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[87] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[88] Final Office Action of Sept. 22, 2004 at page 10. While the Applicant does not appeal the Examiner's rejection of claims 25-29 and 31-34, the Applicant respectfully submits that claim 30,

With regard to claim 30, the Examiner asserts, "Rothschild teaches authenticating access to said remote data store (login)."[89] However, as described above, Rothschild does not teach or suggest any access authenticator for authenticating access to a remote data store. Moreover, also as described above, Rothschild explicitly teaches away from authenticating any access to a remote data store by repeatedly criticizing the authentication required by other systems and methods to deliver medical images.

Also as described above, Parvulescu does not remedy the shortcomings of Rothschild with regard to claim 30. Therefore, neither Rothschild nor Parvulescu, taken alone or in combination, teach or suggest limitations of claim 30. Claim 30 was rejected by the Examiner under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu. The Applicant respectfully submits that the Examiner's final rejection of claim 30 should not be allowed to stand.

VI. The Rejection Of Claim 6 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Xu

The Examiner finally rejected pending claim 6 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Xu.[90] The Applicant has grouped claim 6 by itself

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which depends from claim 25, would be allowable if rewritten in independent form including all of the limitations of claim 25.

[89] Final Office Action of Sept. 22, 2004 at page 9.

[90] Final Office Action of Sept. 22, 2004 at page 5.

because claim 6 depends from claim 1 and includes an additional limitation of restoring medical data from a remote data store to a data source:

> 6. The system of claim 5, wherein said remote data store further restores said medical data to said data source.

The Applicant respectfully submits that Xu is unavailable as a reference under 35 U.S.C. § 103(a) and Rothschild does not teach or suggest restoring medical data to a data source from a remote data store. Therefore, the Applicant submits that claim 6 stands or falls by itself and is patentable under 35 U.S.C. § 103(a) in view of Rothschild.

Moreover, as claim 6 depends from claim 1, if claim 1 is deemed patentable, then claim 6 must also be deemed patentable.[91]

Xu describes PACS archiving techniques. However, Xu is unavailable as a prior art reference under 35 U.S.C. § 103(a). Specifically, 35 U.S.C. § 103(c)(1) states:

> Subject matter developed by another person, which qualifies as prior art only under one or more subsections (e), (f), and (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.[92]

Therefore, Xu is unavailable as an invalidating reference under 35 U.S.C. § 103(a) if the subject matter of Xu: (1) was developed by another person, (2) qualifies as prior art only under 35 U.S.C. § 102(e), (f), and (g), and (3) at the time the invention was made, the

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[91] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[92] 35 U.S.C. § 103(c).

subject matter of Xu and the claimed invention of pending claim 6 were owned by the same person or subject to an obligation of assignment to the same person.

As for the first requirement of 35 U.S.C. § 103(c)(1), the persons listed as inventors of the subject matter of Xu are Xiaofeng Xu and Glenn Robert Kulpinski. The inventors of pending claim 6 are Milton Silvia-Craig, Thanos Karras, and Greg Angst. Therefore, the subject matter of Xu was developed by persons different from the inventors of the invention claimed in pending claim 6.

As for the second requirement of 35 U.S.C. § 103(c)(1), a reference may qualify as prior art only under 35 U.S.C. § 102(e), (f) or (g) if "(e) the invention was described in . . . (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent . . . ."[93] Xu was filed December 16, 1999, before the filing date of the present application. However, Xu did not issue as a patent until January 6, 2004, after the filing date of the present patent application. Therefore, Xu only qualifies as prior art under 35 U.S.C. § 102(e).

As for the final requirement of 35 U.S.C. § 103(c)(1), at the time the invention claimed in claim 6 was made, both the subject matter of Xu and the claimed invention of claim 6 were owned by General Electric Company. Xu was assigned to General Electric Company of Schenectady, New York. The present application was assigned to GE Medical Systems Information Technologies, Inc., of 8200 West Tower Avenue,

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[93] 35 U.S.C. § 102(e).

Milwaukee, Wisconsin 53223-3293, as shown by an assignment recorded on June 20, 2001, at Reel 011920, Frame 0327. GE Medical Systems Information Technologies, Inc. is a corporation that is wholly owned by General Electric Company of Schenectady, New York.

Thus, all three requirements of 35 U.S.C. § 103(c)(1) are met and Xu is unavailable as a reference under 35 U.S.C. § 103(a).

The Examiner recognized in the Final Office Action of Sept. 22, 2004, that "[r]egarding on claim 6, Rothschild does not teach the remote data store further restores said medical data to said data source."[94] Moreover, there is no disclosure in Rothschild discussing any act of transferring, copying or restoring medical data from a remote location to a medical data source, as recited in claim 6. In short, Rothschild does not teach or suggest any communication of medical data from a remote data store to a data source. Thus, Rothschild also does not suggest restoring medical data from a remote data store to a data source.

The Examiner has not provided any additional support (other than Xu) for the 35 U.S.C. § 103(a) rejection of claim 6. Therefore, none of the references cited by the Examiner and available under 35 U.S.C. § 103(a) teach or suggest a limitation of pending

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[94] Final Office Action of Sept. 22, 2004 at page 5.

claim 6.[95] The Applicant therefore respectfully submits that the Examiner's rejection of claim 6 should not be allowed to stand.

Moreover, as claim 6 depends from claim 1, if claim 1 is deemed patentable, then claim 6 must also be deemed patentable.[96]

VII. The Rejection Of Claim 23 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu And Xu

The Examiner finally rejected pending claim 23 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu and Xu.[97] The Applicant has grouped claim 23 by itself because claim 23 depends from claim 15 and includes an additional limitation of restoring medical data from a remote data store to a data source:

> 23. The system of claim 15, wherein said remote data store restores said medical data at said data source.

The Applicant respectfully submits that as none of the available references teach or suggest a remote data store restoring medical data to a data source, claim 23 is patentable over Rothschild and Parvulescu. Moreover, as claim 23 depends from claim 15, if claim 15 is deemed patentable, then claim 23 must also be deemed patentable.[98]

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[95] In addition, although not cited by the Examiner in his 35 U.S.C. § 103(a) rejection of claim 6, Parvulescu, taken alone or in combination with Rothschild, also does not teach or suggest the limitations of claim 6, as described in more detail below in part VII of the Argument section of this Brief.
[96] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[97] Final Office Action of Sept. 22, 2004 at page 10.
[98] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).

As described above, Xu is unavailable as a reference under 35 U.S.C. § 103(a). In addition, the Examiner recognized that "regarding[ ] claims 23 and 35-36 [sic][99], Rothschild does not explicitly teach the remote data store restores said medical data at said data source."[100] As described above in part VI of the Argument section of this Brief, there is no disclosure in Rothschild discussing any act of restoring medical data from a remote location to a data source. Thus, Rothschild also does not suggest restoring medical data from a remote data store to a data source.

Finally, Parvulescu does not remedy the shortcomings of Rothschild. Parvulescu is devoid of any disclosure, description, teaching or suggestion of any transferring, restoring, or copying of medical data to a data source. In short, there is no teaching or suggestion in Parvulescu of communicating medical data from a remote data store to a data source. Therefore, Parvulescu also does not teach or suggest a limitation of claim 23.

A combination of Rothschild and Parvulescu also fails to teach or suggest a remote data store restoring medical data to a data source. As neither reference teaches or suggests such data restoration, a combination of these references similarly cannot teach or suggest a remote data store restoring medical data to a data source.

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[99] The Examiner incorrectly inferred that pending claim 36 includes a limitation of restoring medical data from a remote data store to a data source. However, claim 36 includes a limitation of copying medical data from a remote data store to a second data source. Therefore, this Section of the Brief will only address claims 23 and 35 (the "restoring" claims). Part X of the Argument section of this Brief will address claim 36.

[100] Final Office Action of Sept. 22, 2004 at page 10.

None of the references cited by the Examiner and available as a reference in his rejection under 35 U.S.C. § 103(a) of claim 23 teach or suggest, alone or in combination, limitations of claim 23. Therefore, the Applicant respectfully submits that the rejection of claim 23 under 35 U.S.C. § 103(a) should not be allowed to stand.

Moreover, as claim 23 depends from claim 15, if claim 15 is deemed patentable, then claim 23 must also be deemed patentable.[101]

VIII. The Rejection Of Claim 35 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu And Xu

The Examiner finally rejected pending claim 35 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu and Xu.[102] The Applicant has grouped claim 35 by itself because claim 35 depends from claim 25 and includes an additional limitation of restoring medical data from a remote data store to a data source:

> 35. The method of claim 25, further comprising the step of restoring said medical data to said data source from said remote data store.

As described above, Xu is unavailable as a reference under 35 U.S.C. § 103(a). In addition, the Examiner recognized that "regarding[ ] claims 23 and 35-36 [sic][103],

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[101] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[102] Final Office Action of Sept. 22, 2004 at page 10. While the Applicant does not appeal the Examiner's rejection of claims 25-29 and 31-34, the Applicant respectfully submits that claim 35, which depends from claim 25, would be allowable if rewritten in independent form including all of the limitations of claim 25
[103] The Examiner incorrectly inferred that pending claim 36 includes a limitation of restoring medical data from a remote data store to a data source. However, claim 36 includes a limitation of copying medical data from a remote data store to a second data source. Therefore, this Section

Rothschild does not explicitly teach the remote data store restores said medical data at said data source."[104] As described above in part VI of the Argument section of this Brief, there is no disclosure in Rothschild discussing any act of restoring medical data from a remote location to a data source. Thus, Rothschild also does not suggest restoring medical data from a remote data store to a data source.

Finally, Parvulescu does not remedy the shortcomings of Rothschild. Parvulescu is devoid of any disclosure, description, teaching or suggestion of any type of data restoration to a data source, as described above in part VII of the Argument section of this Brief. Therefore, Parvulescu also does not teach or suggest a limitation of claim 35.

A combination of Rothschild and Parvulescu also fails to teach or suggest a remote data store restoring medical data to a data source. As neither reference teaches or suggests such data restoration, a combination of these references similarly cannot teach or suggest a remote data store restoring medical data to a data source.

None of the references cited by the Examiner and available as a reference in his rejection under 35 U.S.C. § 103(a) of claim 35 teach or suggest, alone or in combination, limitations of claim 35. Therefore, the Applicant respectfully submits that the rejection of claim 35 under 35 U.S.C. § 103(a) should not be allowed to stand.

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of the Brief will only address claims 23 and 35 (the "restoring" claims). Part X of the Argument section of this Brief will address claim 36.

[104] Final Office Action of Sept. 22, 2004 at page 10.

IX. The Rejection Of Claims 15-18, 20, 24 And 54 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu

The Examiner finally rejected pending claims 15-18, 20, 24 and 54 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.[105] For the sake of simplicity, the Applicant will only discuss the substantive merits of the patentability of independent claim 15, as claims 16-18, 20, 24 and 54 each depend from claim 15. Claim 15 recites (with emphasis added):

> 15. A system for remotely accessing a centralized data store, said system comprising:
>
> a centralized remote data store storing medical data indexed according to data source, wherein said medical data comprises at least one of a medical image, a medical report, and a medical application, wherein said centralized remote data store comprises an application service provider;
>
> a status monitor for controlling the transfer of said medical data from said centralized remote data store to a data source, wherein said status monitor monitors actions occurring at said data source and controls said centralized remote data store and said data source to **transfer said medical data from said centralized remote data store to said data source** based on a trigger, wherein said trigger is based on an action occurring at said data source; and

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[105] Final Office Action of Sept. 22, 2004 at page 5.

a data source receiving said medical data and storing said medical data.

Similar to the rejection of pending claim 8, described below, in his rejection of claim 15, the Examiner stated:

> The central data management system (30) actively "push" the electronic record (5) and associated images (6) to the remote image viewing system (40) of the radiologists and referring doctors as soon as the images are available.[106]

Once again, however, the excerpt of Rothschild cited by the Examiner (col. 22, lines 24-28) in support of his rejection merely describes a central data management system sending medical data **to a remote viewing station**, and not to a data source, as recited by claim 15. While Rothschild may disclose transferring medical data from a centralized data management system to a remote viewing system, Rothschild does not teach or suggest transferring medical data from the remote viewing system to a source of medical data.[107] Thus, Rothschild does not teach or suggest a remote data store that transfers medical data to a data source, as recited in pending claim 15.

Parvulescu does not remedy the shortcomings of Rothschild. Specifically, Parvulescu is devoid of any disclosure of transferring medical data to a data source from a centralized remote data store, as recited in pending claim 15.[108] Thus, Parvulescu also does not teach or suggest the same limitation of claim 15 as Rothschild.

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[106] Final Office Action of Sept. 22, 2004 at page 6.
[107] *See* parts VI, VII and VIII of the Argument section of this Brief.
[108] *See* parts VII and VIII of the Argument section of this Brief.

Finally, a combination of Rothschild and Parvulescu also fails to teach or suggest a limitation of claim 15. As described above, neither Rothschild nor Parvulescu, taken alone or in combination, teach or suggest transferring medical data to a data source from a centralized remote data store, as recited in claim 15.

The Examiner provides no other support for his assertion that pending claim 15 is obvious in view of Rothschild and Parvulescu. Each of pending claims 16-18, 20, 24 and 54 depend from claim 15. Therefore, as Rothschild does not teach or suggest elements of pending claim 15, Applicant respectfully submits that the Examiner's rejection of claims 15-18, 20, 24 and 54 under 35 U.S.C. § 103(a) in view of Rothschild and Parvulescu should not be allowed to stand.

Moreover, pending claims 19 and 23 also depend from claim 15. The Applicant has grouped these pending claims separately from claims 15-18, 20, 24 and 54 because each of claims 19 and 23 includes additional patentable limitations, as described in more detail above in parts IV and VII of the Argument section of this Brief. However, if claim 15 is deemed patentable, then claims 19 and 23 must also be deemed patentable.

X. The Rejection Of Claim 8 Under 35 U.S.C. § 103(a) In View Of Rothschild

The Examiner finally rejected pending claim 8 under 35 U.S.C. § 103(a) in view of Rothschild.[109] The Applicant has grouped claim 8 by itself because claim 8 depends

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[109] Final Office Action of Sept. 22, 2004 at page 2.

from claim 1 and includes an additional limitation directed towards medical data being transferred from a remote data store to a second data source (emphasis added):

> 8. The system of claim 1, further comprising a second data source for storing medical data, wherein **said remote data store transfers said medical data to said second data source**.

In his rejection, the Examiner stated:

> [T]he central data management system (30) actively "push" the electronic record (5) and associated images (6) to the remote image viewing system (40) of the radiologists and referring doctors as soon as the images are available.[110]

However, the excerpt of Rothschild cited by the Examiner (col. 22, lines 24-28) in support of his rejection merely describes a central data management system sending medical data **to a remote viewing station**. In other words, Rothschild does not teach sending or pushing medical data from a central data management system to a data source, but rather to a viewing station.

Rothschild repeatedly distinguishes a source of medical data from a remote viewing station. Specifically, the medical imaging system of Rothschild obtains or provides medical data, while a remote viewing station is used to view or experience the medical data obtained by the medical imaging system.

Rothschild repeatedly states that the medical imaging system is the component of the Rothschild invention that obtains or produces the medical data:

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[110] Final Office Action of Sept. 22, 2004 at page 4.

> The medical imaging system **produces** an electronic record in a computer-readable format and that comprises an electronic image associated with a region of a patient's body.[111]
>
> The medical imaging system **produces** the electronic record that comprises an electronic image associated with a region of a patient's body in a computer-readable format.[112]
>
> A patient study or exam is conducted at a medical imaging center using medical imaging system (10) to **obtain** a set of images associated with a targeted region of a patient's body. These images are provided by the medical imaging system in an electronic form as electronic images (6) that are part of an electronic record . . . .[113]

In short, the medical imaging system of Rothschild produces, obtains or otherwise creates medical data.

Rothschild also repeatedly states that the remote viewing systems are used by physicians, doctors, and radiologists to "experience," view, analyze or manipulate the medical images associated with the medical data:

> The remote image viewing system (40) is how physicians and other users outside of the imaging center will **"experience" images** transported according to the invention, and thus the system (40) [m]ust be provided in a form that is well accepted by the medical community in particular. In a further aspect beneficial to healthcare providers, payers, and patient's alike, this viewer may be used, free of charge, **to view and analyze images** transported according to the invention . . . .[114]
>
> In order to **display and manipulate the received images**, the invention in one aspect includes remote viewing system (40) that all radiologists and

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[111] Rothschild at col. 8, lines 48-51 (emphasis added).
[112] Rothschild at col. 12, lines 23-25 (emphasis added).
[113] Rothschild at col. 18, lines 42-47 (emphasis added).
[114] Rothschild at col. 24, lines 29-37 (emphasis added).

> referring doctors must use in conjunction with the image delivery service of the invention.[115]

In short, the remote viewing system of Rothschild does not obtain or produce medical data, but is instead used to view or display medical data obtained or produced by the medical imaging system. While the second of the above quotations from Rothschild does state that the remote viewing system is used to "manipulate" received images, Rothschild limits such manipulation to adjusting the display characteristics of the images:

> The remote image viewing system (40) preferably gives the physician the ability to change display formats, window and level the image (adjust the brightness and contrast), magnify the image, manipulate the grayscale, measure the anatomy and pathology, easily identify spatial locations, and to the extent there is direct-capture and lossless transmission make exact measurements and determine the location of abnormalities for surgical planning.[116]

This ability to manipulate the display of images at the remote viewing system is not the production or obtaining of medical data. The medical images have already been obtained or produced by the medical imaging system of Rothschild. The remote viewing system merely provides doctors with the ability to alter the display of the images to suit the doctors' needs. In short, the remote viewing systems view medical data, but do not obtain or produce medical data.

Also, while Rothschild does disclose the remote viewing system communicating electronic records to the central data management system, this disclosure is limited to users of the remote viewing systems updating electronic records with new diagnostic

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[115] Rothschild at col. 24, lines 5-9.
[116] Rothschild at col. 24, lines 15-23.

information and attaching reports to existing medical data that was obtained or produced by the medical imaging system:

> FIG. 4 also shows electronic records (5) via flow arrows pointing in each of two opposite directions. This is intended to represent both forward and reverse flow of information related to the records (5), such as **returning updated versions of the records (5) with new diagnostic information** flowing from the remote image viewing system user according to various of the particular embodiments herein described and shown in the Figures. In particular, interpreting physicians, payers, and other parties outside of the medical imaging center and representing the remote image viewing systems of the invention will often **attach reports to the electronic record** for others to see, including the medical imaging center itself and other physicians. This is represented by the reverse flow of electronic record (5) as shown in FIG. 4, and the respective reports, etc., are shown schematically in FIG. 2 as new information (7') which is attached to the "header" or "data" section of electronic record (5) along side of the electronic image (6). [117]

By updating diagnostic information or attaching a report to an **existing** electronic medical record, the remote viewing systems of Rothschild do not perform the actions of a data source. The medical data has already been produced or obtained by the medical imaging systems of Rothschild—the remote viewing stations merely contribute to this data.

Rothschild is devoid of any additional disclosure, teaching or suggestion of producing or obtaining medical data at any location other than the medical imaging system. Therefore, the remote viewing systems of Rothschild are not sources of medical data.

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[117] Rothschild at col. 23, lines 1-18 (emphasis added).

While Rothschild may disclose transferring medical data from a centralized data management system to a remote viewing system, Rothschild does not teach or suggest transferring medical data from the remote viewing system to a source of medical data. Thus, Rothschild does not teach or suggest a remote data store that transfers medical data to a data source, as recited in pending claim 8.[118]

In conclusion, the Examiner's rejection of claim 8 under 35 U.S.C. § 103(a) in view of Rothschild should not be allowed to stand. Moreover, as claim 8 depends from claim 1, if claim 1 is deemed patentable, then claim 8 must also be deemed patentable.[119]

XI. The Rejection Of Claim 36 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu And Further In View Of Xu

The Examiner finally rejected pending claim 36 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu and further in view of Xu.[120] Claim 36 recites (with emphasis added):

> 36. The method of claim 25, further comprising the step of copying said medical data from said remote data source to a second data source.

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[118] As described in more detail below, Parvulescu also fails to teach or suggest a remote data store that transfers medical data to a second data source, even though pending claim 8 was not rejected under 35 U.S.C. § 103(a) in view of Parvulescu. In addition, Xu is unavailable as a reference for a 35 U.S.C. § 103(a) rejection. Therefore, even though neither Parvulescu nor Xu were cited in the § 103(a) rejection of claim 8, neither Rothschild nor Parvulescu (the only two available references under § 103(a)), alone or incombination, teach or suggest limitations of claim 8.
[119] MPEP § 2143.03 at 133 (citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988)).
[120] Final Office Action of Sept. 22, 2004 at page 10.

In accordance with an embodiment of the present invention, medical data may obtained by a first data source, archived at the remote data store, and then copied to a second data source.[121] Such a copy or transfer of medical data may be used to copy or transfer medical data obtained by one data source to a new, upgraded, or replacement data source (the second data source), for example.[122]

As described above in part X of the Argument section of this Brief, neither Rothschild nor Parvulescu, taken alone or in combination, teach or suggest transferring medical data from a remote data store to a data source. If neither Rothschild nor Parvulescu teach or suggest transferring medical data from a remote data store to a data source, then neither Rothschild nor Parvulescu can teach or suggest transferring medical data from a remote data store to a **second** data source, as recited in claim 36.

Also as described above in part VI of the Argument section of this Brief, Xu is unavailable as a reference under a 35 U.S.C. § 103(a) rejection. Therefore, none of the available references cited by the Examiner teach or suggest, alone or in combination, limitations of claim 36. Thus, the Applicant respectfully submits that the Examiner's § 103(a) rejection of claim 36 should not be allowed to stand.

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[121] *See, e.g.*, '471 Specification at page 13, lines 27-31 and page 14, lines 1-13.
[122] '471 Specification at page 13, lines 20-31 and page 14, lines 1-25.

XII. The Rejection Of Claim 53 Under 35 U.S.C. § 103(a) In View Of Rothschild And Further In View Of Parvulescu

In the Final Office Action of September 22, 2004, the Examiner finally rejected claim 53 under 35 U.S.C. § 103(a) in view of Rothschild and further in view of Parvulescu.[123] Claim 53 is directed towards a dedicated network connection for transferring medical data between a data source and a remote data store:

> 53. The system of claim 1, further comprising a dedicated network connection for transferring said medical data between said medical data source and said centralized remote medical data store.

In rejecting claim 53, the Examiner stated:

> Regarding on claim 53, Rothschild teaches a dedicated network connection for transferring said medical data between said medical data source and said centralized remote medical data store (col. 19, lines 36-39).[124]

However, the excerpt from Rothschild cited by the Examiner does not teach or suggest a dedicated network connection for transferring medical data between a data source and a remote data store. When read in the context of the preceding and following text of Rothschild, the excerpt reads:

> Local image workstation (20) is located at the medical imaging center and communicates with a medical imaging system (10) generally onsite at the center's location via a local interface (15). The terms "'local interface" are herein intended to mean interfaces that use locally managed and generally non-publicly accessed and used networks and routers. For the purpose of further illustration, local interfaces according to the intended meaning include without limitation hard-wired direct interfaces,

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[123] Final Office Action of Sept. 22, 2004 at page 5.
[124] Final Office Action of Sept. 22, 2004 at page 10.

> extensions of data paths, and locally routed and/or managed LANs or telecommunication interfaces such as telephone lines that when used according to the invention do not extend beyond a locally and generally privately managed and used router and therefore generally do not use publicly accessed and used telecommunications networks, nodes, or routers.[125]

In other words, Rothschild describes a connection between a local image workstation and a medical imaging system that is "locally managed and generally non-publicly accessed and used . . . ."[126] As described above, Rothschild's medical imaging system is a source of medical data, as the medical imaging system is the system "that provides images in electronic form for electronic delivery."[127] The local image workstation of Rothschild "acquire[s] the electronic image data from the imaging system."[128] The excerpt cited by the Examiner in rejecting claim 53 therefore relates to the connection between a data source that provides electronic images (local imaging system) and an image acquisition device (local image workstation). The excerpt does not describe any type of connection between a data source and a remote data store, as recited in claim 53.

In contrast, in describing connections between a data source and a central data management system and connections between the central data management system and a remote viewing system, Rothschild explicitly teaches away from using dedicated network connections for transferring medical data by only describing connections over publicly accessible networks. Specifically, Rothschild describes the communication of medical

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[125] Rothschild at col. 19, lines 33-47.
[126] Rothschild at col. 19, lines 37-38.
[127] Rothschild at col. 19, lines 21-22.
[128] Rothschild at col. 19, line 50.

data between the medical imaging system and the central data management system as occurring over non-dedicated, publicly accessible networks:

> Central data management system (30) is generally located remotely from the medical imaging center, and **communicates with local image workstation (20) via a remote interface** (25). . . .
>
> The terms "remote interface" are herein intended to mean interfaces that use wide area networks (WANs) or other **publicly accessed** and centrally managed networks or routers such as for example cable networks and publicly accessed telecommunications networks, nodes, and routers. Therefore, in another sense remote interfaces are communication interfaces that reach beyond local interfaces as described herein. In one highly beneficial mode, the remote interfacing with the central data management system (30) for the push transfer of images to and from that central image management system will employ fast digital lines and flow **over the Internet**.[129]
>
> Therefore, at each of the locations where the images would be needed, the remote image viewing station (40) would be running and available at all times **on the Internet in order to achieve immediate "push" delivery of the images** as soon as they become available.[130]

In fact, Rothschild repeatedly touts using the Internet for the connection between the various components of his invention:

> The systems and methods of the invention for managing medical images electronically over remote interfaces such as **via the internet** also allow for a highly economical method for providing a medical image management ASP in a manner that expands the bottom line for medical imaging centers in particular.[131]
>
> With the recent advent of broadband Internet connections, which by the end of 2001 will be available to the majority of the population in the form of Digital Subscriber Lines (DSL), continued adoption of this communication mode by the healthcare community will expand the

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[129] Rothschild at col. 20, line 49 through col. 21, line 6 (emphasis added).
[130] Rothschild at col. 22, lines 33-38.
[131] Rothschild at col. 14, lines 36-41.

> significant transition in the way images are managed between remote locations according to the management system and method of the invention.[132]
>
> The referring physicians and other users of the invention will be strongly encouraged to use DSL for interfacing the remote image viewing system (40) with the central data management system (30) of the invention since this provides for fastest and economical Internet access. Moreover, it is preferred that **the Internet connection between the central data management system (30) and the remote viewing system** be continuously online in order to best facilitate the "push" delivery aspect of the invention.[133]

Therefore, Rothschild describes non-dedicated and publicly available connections between the imaging system and the central data management system, and between the central data management system and the remote viewing system. Rothschild does not teach or suggest the use of any dedicated connection between any of these components of the Rothschild invention for communicating medical data. As a non-dedicated, publicly available network connection differs substantially from a dedicated connection, Rothschild teaches away from using a dedicated network connection for transferring medical data. Thus, Rothschild does not teach or suggest limitations of claim 53.

In addition, Parvulescu does not remedy the shortcomings of Rothschild. Parvulescu does disclose the use of various networks for transferring medical images from a medical imaging device to a medical image archiving device. Specifically,

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[132] Rothschild at col. 18, lines 21-27.
[133] Rothschild at col. 25, lines 11-17.

Parvulescu discloses the use of a Wide Area Network ("WAN"), a Local Area Network ("LAN"), or the Internet as the network connections for transferring medical data.[134]

However, while Parvulescu may disclose the use of various networks for transferring medical images from a medical imaging device to a medical image archiving device, none of the disclosed networks include a dedicated network connection. That is, Parvulescu is devoid of any disclosure of a connection between an imaging device and an archiving device, where the connection is dedicated to the communication of medical images between the two devices. Therefore, Parvulescu does not teach or suggest a dedicated network connection for transferring medical data between a data source and a remote data store, as recited in claim 53.

Moreover, a combination of Rothschild and Parvulescu similarly fails to teach or suggest elements of claim 53. As described above, neither Rothschild nor Parvulescu teach or suggest the use of a dedicated network connection for transferring medical data between a data source and a remote data store. Therefore, a combination of Rothschild and Parvulescu similarly fails to teach or suggest such a dedicated connection. Thus, a combination of Rothschild and Parvulescu does not teach or suggest limitations of claim 53.

The Applicant respectfully submits that the Examiner's § 103(a) rejection of claim 53 should not be allowed to stand. Moreover, as claim 53 depends from claim 1, if claim 1 is deemed patentable, then claim 53 must also be deemed patentable.

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[134] Parvulescu at col. 1, lines 61-64 and col. 3, lines 19-26.

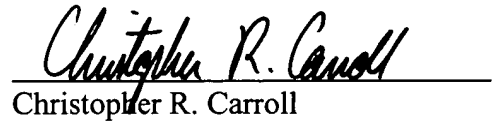
CONCLUSION

For the foregoing reasons, claims 1-8, 11-20, 23-24, 30, 35-36 and 53-54 are distinguishable over the prior art. The Applicant has worked with the Examiner through requests for continued examination, telephonic interviews, and amendments to claims to reach agreement with the Examiner despite a lack of relevant prior art. The Examiner has been afforded the opportunity through multiple RCEs to search the prior art and find references which anticipate or render obvious the pending claims. Thus, the Applicant respectfully requests a reversal of the Examiner's rejection and issuance of a patent on the present application.

The Commissioner is authorized to charge any necessary fees or credit any overpayment to the Deposit Account of GEMS-IT, Account No. 50-2401.

Respectfully submitted,

Date: August 4, 2005



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CLAIMS APPENDIX

Below is a copy of the claims involved in the present appeal:

1. A central medical data archiving system, said system comprising:

a medical data source providing medical data, wherein said medical data comprises at least one of a medical image, a medical patient report, and a medical application;

a status monitor for controlling the transfer of said medical data from said data source to a centralized remote data store, wherein said status monitor monitors operations occurring at at least one of said data source and centralized remote data store and triggers transfer of said medical data to said centralized remote data store based on said operations; and

a centralized remote medical data store receiving said medical data and storing said medical data, wherein said centralized remote medical data store comprises an application service provider.

2. The system of claim 1, wherein said status monitor verifies said transfer of said medical data from said data source to said remote data store.

3. The system of claim 1, further comprising an access authenticator for authenticating access to said remote data store by said data source.

4. The system of claim 3, wherein said access authenticator authenticates access to said data source.

5. The system of claim 1, wherein said data source further stores medical data.

6. The system of claim 5, wherein said remote data store further restores said medical data to said data source.

7. The system of claim 1, wherein said remote data store stores a copy of said medical data.

8. The system of claim 1, further comprising a second data source for storing medical data, wherein said remote data store transfers said medical data to said second data source.

11. The system of claim 1, wherein said status monitor controls the transfer of data from said data source to said remote data store at a definable interval.

12. The system of claim 11, wherein said definable interval comprises a timed interval.

13. The system of claim 11, wherein said definable interval comprises an event-based interval.

14. The system of claim 11, wherein said definable interval comprises a manual interval.

15. A system for remotely accessing a centralized data store, said system comprising:

a centralized remote data store storing medical data indexed according to data source, wherein said medical data comprises at least one of a medical image, a medical report, and a medical application, wherein said centralized remote data store comprises an application service provider;

a status monitor for controlling the transfer of said medical data from said centralized remote data store to a data source, wherein said status monitor monitors actions occurring at said data source and controls said centralized remote data store and said data source to transfer said medical data from said centralized remote data store to said data source based on a trigger, wherein said trigger is based on an action occurring at said data source; and

a data source receiving said medical data and storing said medical data.

16. The system of claim 15, further comprising a second data source storing medical data.

17. The system of claim 16, wherein said status monitor controls the transfer of said copy of said medical data between said remote data store and said second data source.

18. The system of claim 16, wherein said status monitor verifies the transfer of said copy of said medical data between said remote data store and said second data source.

19. The system of claim 15, further comprising an access authenticator for authenticating access to said remote data store.

20. The system of claim 15, wherein said status monitor verifies said transfer of said medical data between said data source and said remote data store.

23. The system of claim 15, wherein said remote data store restores said medical data at said data source.

24. The system of claim 15, wherein said remote data store comprises at least one directory corresponding to said data source.

25. A method for remotely archiving medical data, said method comprising:

detecting an operation involving medical data executed at a medical data source;

transferring said medical data from said medical data source to a centralized remote data store based on a trigger, wherein said trigger is produced based on said operation executed at said data source, wherein said medical data comprises at least one of a medical image, a medical report, and a medical application;

storing said medical data at said centralized remote data store; and

indexing said medical data according to said data source.

26. The method of claim 25, further comprising the step of obtaining said medical data.

27. The method of claim 25, further comprising the step of storing said medical data at said data source.

28. The method of claim 25, wherein said storing step further comprises storing said medical data at said remote data store in a directory corresponding to said data source.

29. The method of claim 25, wherein said transferring step further comprises verifying said transfer of medical data from said remote data store to said data source.

30. The method of claim 25, further comprising the step of authenticating access to said remote data store.

31. The method of claim 25, wherein said transferring step occurs after a definable interval.

32. The method of claim 31, wherein said definable interval comprises a timed interval.

33. The method of claim 31, wherein said definable interval comprises an event-based interval.

34. The method of claim 31, wherein said definable interval comprises a manual interval.

35. The method of claim 25, further comprising the step of restoring said medical data to said data source from said remote data store.

36. The method of claim 25, further comprising the step of copying said medical data from said remote data source to a second data source.

53. The system of claim 1, further comprising a dedicated network connection for transferring said medical data between said medical data source and said centralized remote medical data store.

54. The system of claim 15, further comprising a private network connection for transferring said medical data between said data source and said centralized remote data store.

EVIDENCE APPENDIX

This Appendix contains copies of evidence entered by the Examiner and relied upon by the Appellant in the present appeal. The following is a list of such evidence along with a statement setting forth where in the record the evidence was entered in the record by the Examiner.

(1) Final Office Action mailed and entered into the record by the Examiner on September 22, 2004.

This Appendix also contains copies of the evidence relied on by the Examiner as to grounds of rejection to be reviewed on appeal. The following is a list of such evidence.

(A) U.S. Patent No. 6,678,703 to Rothschild et al.

(B) U.S. Patent No. 6,675,271 to Xu et al.

(C) U.S. Patent No. 6,678,764 to Parvulescu et al.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/681,471	04/13/2001	Milton Silva-Craig	15-IS-5715	7327

23446 7590 09/22/2004

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EXAMINER	
TO, BAOQUOC N	

ART UNIT	PAPER NUMBER
2172	14

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

RESPONSE DUE:
Nov 22 2004
Amendment

RESPONSE DUE:
Dec 22 2004
Ntc of Appeal

Office Action Summary	Application No.	Applicant(s)	
	09/681,471	SILVA-CRAIG ET AL.	
	Examiner	Art Unit	
	Baoquoc N To	2172	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 December 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,11-20,23-36,53 and 54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,11-20,23-36,53 and 54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1, 15 and 25 are amended, claims 9-10 and 21-22 are canceled, and claims 53-54 are newly added. Claims 1-8, 11-20, 23-36 and 53-54 are pending in this application.

Response to Arguments

2. Applicant's arguments with respect to claims 1, 15 and 25 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-5, 7-811-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rothschild et al. (US. Patent No. 6,678,703 B2).

Regarding on claims 1, Rothschild teaches a central medical data archiving system, said system comprising:

A medical data source providing medical data, where said medical data comprises at least one of a medical image, a medical patient report, and a medical application (a medical imaging system 10) (col. 18, lines 29-31);

A status monitor for controlling the transfer of said medical data from said data source to a centralized remote data store, where said status monitor monitors

operations occurring at at least one of said data source and centralized remote data store and triggers transfer of said medical data to said centralized remote data store based on said operations (the medical image centers track the entire process of image workstation (20) merely by reference to the local image workstation (20) located in their respective clinic or hospital) (col. 29, lines 12-16); and

A centralized remote medical data store receiving said medical data and storing said medical data, wherein said centralized remote medical data store comprises an application service provider (ASP delivery the medical image from the medical image system 10 to the central severs (30' and 30") (col. 28, lines 32-67).

Although, Rothschild does not explicitly teach the status monitor for controlling the transfer of said medical data from said data source to a centralized remote data store. However, Rothschild discloses medical image center track the entire process of image delivery and review from the local image workstation (20) merely by reference to the local image workstation (20) located in their respective clinic or hospital. The medical image center is the status monitor. Therefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify Rothschild's system to include the medical image center to perform the same functionality as the claimed invention.

Regarding on claim 2, Rothschild teaches status monitor verifies said transfer of said medical data from said data source to said remote data store (col. 29, lines 16-29).

Regarding on claim 3, Rothschild teaches an access authenticator for authenticating access to said remote data store by said data source (login) (col. 22, line 29).

Regarding on claim 4, Rothschild teaches access authenticator authenticates access to said data source (login) (col. 22, line 29).

Regarding on claim 5, Rothschild teaches said data source further stores medical data (the local workstation stored medical image data) (col. 28, lines 41-48).

Regarding on claim 7, Rothschild teaches the remote data store stores a copy of said medical data (the central storage system (130) stores all electronic record (5) at two central back-up sites one at 30' and 30") (col. 28, lines 41-51).

Regarding on claim 8, Rothschild teaches a second data source for storing medical data, wherein said remote data store transfers said medical data to said second data source (the central data management system (30) actively "push" the electronic record (5) and associated images (6) to the remote image viewing system (40) of the radiologists and referring doctors as soon as the images are available) (col. 22, lines 24-28).

Regarding on claims 11-14, Rothschild teaches the automatically pushes to the medical images to the remote image viewer and the backup sites (col. 28, lines 59-62). Therefore, the system of Rothschild does not need to employ the time interval or event-based interval or a manual interval.

4. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rothschild et al. (US. Patent No. 6,678,703) in view of Xu et al. (US. Patent No. 6,675,271 B1).

Regarding on claim 6, Rothschild does not teach the remote data store further restores said medical data to said data source. However, Xu teaches "by using the foregoing techniques, security can be provided for image data and other medical data. The data can be quickly and conveniently restored in the event of failure, during servicing and during archive or medium replacement" (col. 1, lines 29-32). This teaches the restore is done in the event of failures. Therefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify Rothschild's system to include the restore in the event of failure as taught in Xu in order to restore the original files back to the system.

5. Claims 15-20, 24-34 and 53-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rothschild et al. (US. Patent No. 6,678,703 B2) in view of Parvulescu et al. (US. Patent No. 6,678,764 B2).

Regarding on claim 15, Rothschild teaches a system for remotely accessing a centralized data store, said system comprising:

A centralized remote data store storing medical data indexed according to data source, wherein said medical data comprises at least one of a medical image, a medical report, and a medical application, wherein said centralized remote data store comprises an application service provider (the central data management system stores the

information from the automated forms of entry to the record via the respective local image workstation (20)) (col. 22, lines 25-67);

A status monitor for controlling the transfer of said medical data from said centralized remote data store to a data source, wherein said status monitor monitors actions occurring at data source and controls said centralized remote data store and said data source to transfer said medical data from said centralized remote data store to said data source based on trigger, wherein said trigger is based on an action occurring at said data source (The central data management system (30) actively "push" the electronic record (5) and associated images (6) to the remote image viewing system (40) of the radiologists and referring doctors as soon as the images are available) (col. 22, lines 24-28); and

A data source receiving said medical data and storing said medical data (each of the location s where the image needed, the remote image viewing station (40) would be running and available at all times on the Internet in order to achieve immediate "push" delivery of the image as soon as they become available) (col. 22, lines 33-39).

Rothschild teaches the centralized data management system received and stored in the central database (30' and 30"). However, Rothschild does not teach the medical data stored in the centralized remote data store, is indexed. On the other hand, Parvulescu teaches the medical image processing system (title) which allows the stored images are indexes via a predictable syntax, whether the user enters specific information via a keyboard or handheld terminal 212 (e.g., patient and doctor names), or uses the image archiving device 100 without the keyword or terminal 212) (col. 4,lines

51-56). Therefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify Rothschild's system to include the indexing the medical images as taught in Parvelescu in order to ease future management and retrieval of image.

Regarding on claim 16, Rothschild teaches a second data source storing medical data (a remote user) (col. 22, lines 35-40).

Regarding on claim 17, Rothschild teaches the status monitor controls the transfer of said copy of said medical data between said remote data store and said second data source (location identified) (col. 22, lines 35-40).

Regarding on claim 18, Rothschild teaches the status monitor verifies the transfer of said copy of said medical data between said remote data store and said second data source (it also assures prompt delivery of a report from the remote user and back through the ASP system to other location identified) (col. 22, lines 38-40).

Regarding on claim 19, Rothschild teaches an access authenticator fro authenticating access to said remote data store (login) (col. 22, lines 28-30).

Regarding on claim 20, Rothschild teaches the status monitor verifies said transfer of said medical data between data source and said remote data store (it also assures prompt delivery of a report from the remote user and back through the ASP system to other location identified) (col. 22, lines 38-40).

Regarding on claim 24, Rothschild does not explicitly teach the remote data store comprises at least one directory corresponding to said data source. However,

Parvulescu teaches "so, if Doctor Gooden is performing the procedures on patient John Doe, then the captured images are stored in a folder called "Gooden", with each file in the folder incorporating a standard syntax including patient's name, image number, hospital/practice name, time & date, and procedure information as described above" (col. 9, lines 23-28). This teaches the captured images of the treated patient are organized in the memory as the folder or directory. Therefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify the Rothschild's system to include the captured images data to store in the folder or directory in order to easily retrieve the file the in the organized database.

Regarding on claim 25, Rothschild teaches a method for remotely archive data said method comprising:

Detecting an operation involving medical data executed at a medical data source (soon as the record input to a local image work station, the database management automatically pushes the electronic records and associated images to the remote image viewing system) (col. 22, lines 24-67);

Transferring said medical data from said medical data source to a centralized remote data store based on a trigger, wherein said trigger is produced based on said operation executed at said data source, wherein said medical data comprises at least one of a medical image, a medical report, and a medical application (the medical image of the patient is automatically pushed to the remote image viewing as soon as record inputted) (col. 22, lines 24-67);

Storing said medical data at said centralized remote data store (a central storage system (130) associated with central data management system (30) stores all electronic records (5) at two central back-up site (30', 30") (col. 28, lines 59-62); and

Rothschild teaches storing the medical data into the central backup site (30' and 30") excepting for indexing said medical data according to said data source. However, Parvulescu teaches, "in accordance with a preferred embodiment, the stored images are indexes via a predictable syntax" (col. 4, lines 51-60). Therefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify Rothschild's system to include the indexing the medical images as taught in Parvelescu in order to ease future management and retrieval of image.

Regarding on claim 26, Rothschild teaches the step of obtaining said medical data (col. 22, lines 66-67).

Regarding on claim 27, Rothschild teaches the step of storing said medical data at said data source (stored at the workstation) (col. 22, lines 46-48).

Regarding on claim 28, teaches storing step further comprises storing said medical data at said remote data store in a directory in a directory corresponding to said data source.

Regarding on claim 29, teaches transferring step further comprises verifying said transfer of medical data from said remote data store to said data source (col. 32, lines 35-39).

Regarding on claim 30, Rothschild teaches authenticating access to said remote data store (login) (col. 22, line 29).

Regarding on claims 31-34, Rothschild teaches the automatically pushes to the medical images to the remote image viewer and the backup sites (col. 28, lines 59-62). Therefore, the system of Rothschild does not need to employ the time interval or event-based interval or a manual interval.

Regarding on claim 53, Rothschild teaches a dedicated network connection for transferring said medical data between said medical data source and said centralized remote medical data store (col. 19, lines 36-39).

Regarding on claim 54, Rothschild teaches a private network connection for transferring said medical data between said data source and said centralized remote data store (non publish accessed) (col. 19, lines 36-39).

6. Claims 23 and 35-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rothschild et al. (US. Patent No. 6,678,703 B2) in view of Parvulescu et al. (US. Patent No. 6,678,764 B2) and further in view of Xu et al. (US. Patent No. 6,675,271 B1).

Regarding on claims 23 and 35-36, Rothschild does not explicitly teach the remote data store restores said medical data at said data source. However, Xu teaches "by using the foregoing techniques, security can be provided for image data and other medical data. The data can be quickly and conveniently restored in the event of failure, during servicing and during archive or medium replacement" (col. 1, lines 29-32). This teaches the restore is done in the event of failures. Therefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify

Rothschild's system to include the restore in the event of failure as taught in Xu in order to restore the original files back to the system.

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Baoquoc N. To whose telephone number is (703) 305-1949 or via e-mail BaoquocN.To@uspto.gov. The examiner can normally be reached on Monday-Friday: 8:00 AM – 4:30 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Breene can be reached at (703) 305-9790.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks
Washington, D.C. 20231.

The fax numbers for the organization where this application or proceeding is assigned are as follow:

(703) 872-9306 [Official Communication]

Hand-delivered responses should be brought to:

Crystal Park II
2121 Crystal Drive
Arlington, VA 22202
Fourth Floor (Receptionist).

Baoquoc N. To
September 15, 2004

JEAN M. CORRIELUS
PRIMARY EXAMINER

Notice of References Cited	Application/Control No. 09/681,471	Applicant(s)/Patent Under Reexamination SILVA-CRAIG ET AL.	
	Examiner Baoquoc N To	Art Unit 2172	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,675,271	01-2004	Xu et al.	711/161
	B	US-6,678,764	01-2004	Parvulescu et al.	707/10
	C	US-6,678,703	01-2004	Rothschild et al.	707/201
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

US006675271B1

(12) **United States Patent**
Xu et al.

(10) **Patent No.: US 6,675,271 B1**
(45) **Date of Patent: Jan. 6, 2004**

(54) **PACS ARCHIVE TECHNIQUES**

(75) Inventors: **Xiaofeng Xu**, Des Plaines, IL (US); **Glenn Robert Kulpinski**, Tinley Park, IL (US)

(73) Assignee: **General Electric Company**, Schenectady, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/464,246**

(22) Filed: **Dec. 16, 1999**

(51) **Int. Cl.**[7] **G06F 12/00**

(52) **U.S. Cl.** **711/161**; 711/114; 711/162; 711/170; 711/172; 705/2; 705/3; 600/300; 600/425

(58) **Field of Search** 711/114, 115, 711/117, 161–162; 707/200, 204; 705/2, 3; 379/106.02; 600/300, 425; 345/555; 709/247; 710/68

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,652,999 A		3/1987	Higashi et al.	
5,235,510 A	*	8/1993	Yamada et al.	600/300
5,276,867 A	*	1/1994	Kenley et al.	395/600
5,446,861 A	*	8/1995	Idleman et al.	711/100
5,586,262 A	*	12/1996	Komatsu et al.	705/2
5,619,995 A	*	4/1997	Lobodzinski	348/77
5,751,997 A	*	5/1998	Kullick et al.	709/215
5,829,046 A	*	10/1998	Tzelnic et al.	711/100
5,867,821 A	*	2/1999	Ballantyne et al.	705/2
6,104,859 A	*	8/2000	Yoshida et al.	386/80
6,349,373 B2	*	2/2002	Sitka et al.	711/161
6,353,878 B1	*	3/2002	Dunham	707/10
6,370,630 B1	*	4/2002	Mizuyabu et al.	711/167

FOREIGN PATENT DOCUMENTS

JP 407141498 A * 6/1995 ..... H04N/5/76

OTHER PUBLICATIONS

PACS Basic Principles and Applications, H.K. Huang, (A. John Wiley & Sons Publication 1999): "Picture Archiving and Communication System Components and Industrial Standards", Ch. 7, pp. 177–198A.

PACS Basic Principles and Applications, H.K. Huang (A. John Wiley & Sons Publication 1999): "Image Acquisition Gateway", Ch. 8, pp. 199–231;A. John Wiley & Sons Publication 1999.

PACS Basic Principles and Applications, H.K. Huang (A. John Wiley & Sons Publication 1999): "Display Workstation", Ch. 12, pp. 305–342.

http://www.fujindt.com/medical/; Fujifilm, Medical Imaging—Computed Radiography; author unknown, date unknown, printed on Nov. 18, 1999. Html pages: cr_process1; cr_process2; html pp: cr_process1; cr_process2; cr_process3; cr_process4; cr_process5; cr_process6; cr_basics; cr_whyfuji; advance; cr_synapse; crvsder; cr_application; cr_reference.

* cited by examiner

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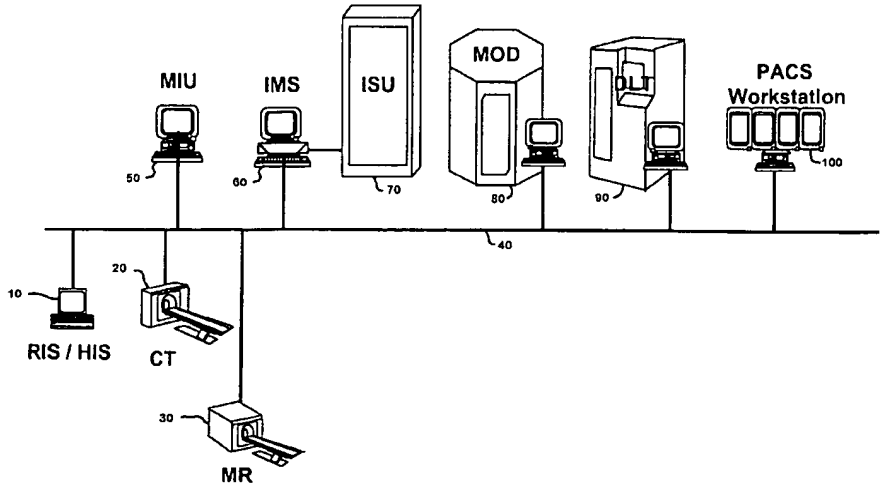
(57) **ABSTRACT**

A PACS including a source of medical data, such as a CT unit (**20**), a workstation (**100**) capable of creating an image of the data, and a local area network (**40**). A server (**60**) stores compressed medical data in a RAID (**70**) and also in a magneto-optical unit (**80**) and a tape DLT unit (**90**). The tape unit (**90**) has a transfer rate equal to or greater than the transfer rate of the RAID.

21 Claims, 1 Drawing Sheet



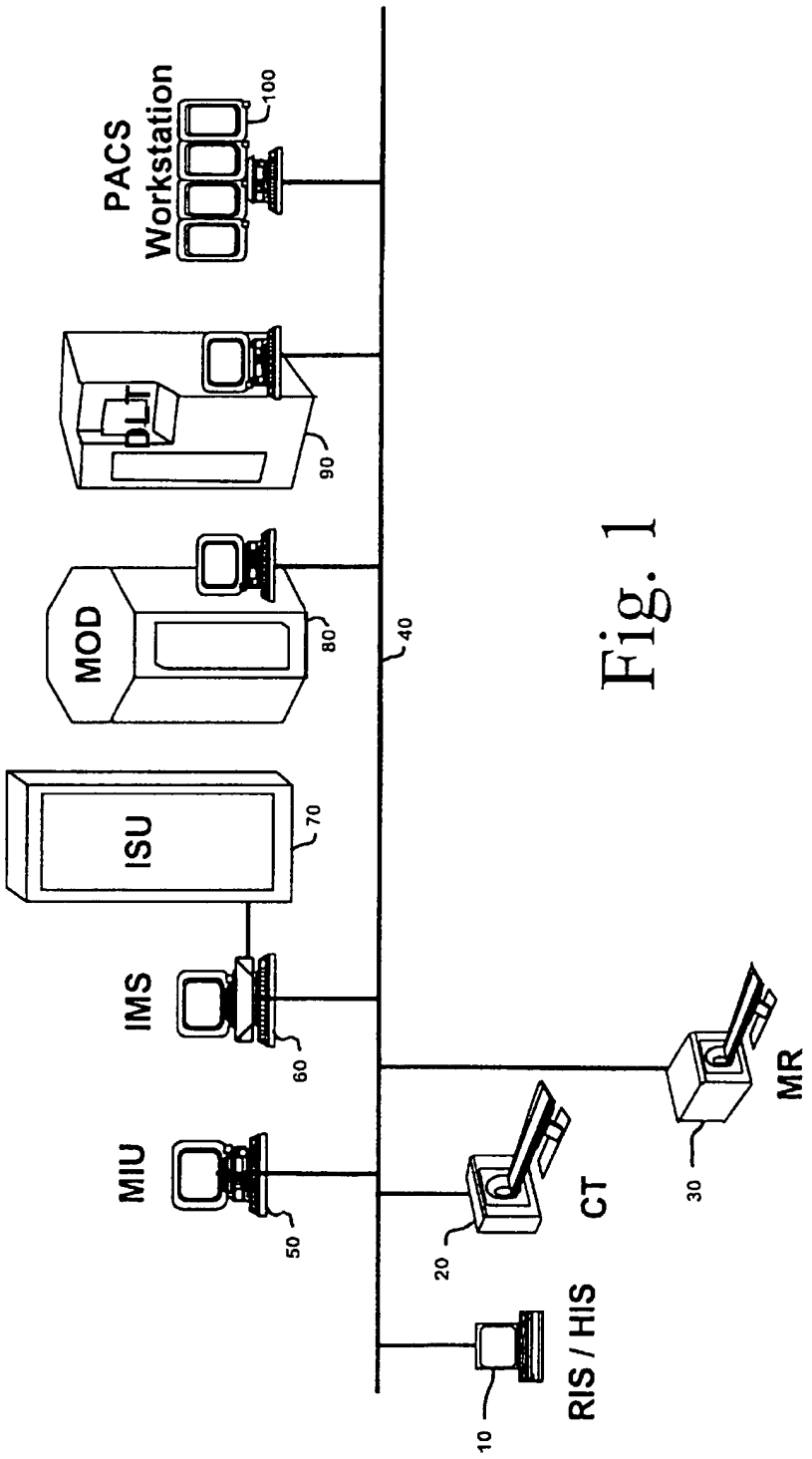

PACS
Workstation
100
DLT
90
MOD
80
40
ISU
70
IMS
60
MIU
50
RIS / HIS
10
CT
20
MR
30

Fig. 1

PACS ARCHIVE TECHNIQUES

BACKGROUND OF THE INVENTION

This invention relates to picture archive and communication systems (PACS), and more specifically relates to archiving data in such systems.

Archive storage in PACS systems is provided for backing up images and other data once the data is not necessary at a short-term storage site. The archives are not redundant and there is a possibility that large quantities of information may be lost in the event of failure or servicing of the archive. This invention addresses the problem and provides one solution.

BRIEF SUMMARY OF THE INVENTION

The preferred embodiment of the invention is useful in a picture archive and communication system for archiving medical data. In such an environment, the preferred embodiment typically includes a source of medical data, a network, a first memory and a second memory. Data is received from the source of medical data, preferably over the network, and is stored, preferably in the first memory. The data then is transferred from the first memory to the second memory, preferably via the network, before the capacity of the first memory is exceeded. At some time, the stored data is transferred from the first memory or the second memory to the workstation to create an image.

By using the foregoing techniques, security can be provided for image data and other medical data. The data can be quickly and conveniently restored in the event of a failure, during servicing and during archive or medium replacement.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram of a preferred form of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **1**, a preferred form of the invention includes a radiology information system (RISIHIS) **10** which provides image data derived from x-rays of patients. A computed tomography (CT) unit **20** provides image data derived from scans of patients, and a magnetic resonance (MR) unit **30** provides image data from additional scans of patients. System **10** and units **20** and **30** also may provide text data about the image data generated by the respective units or about the circumstances of the patients or procedures from which the image data was derived. For example, the system and units may provide the name of the patient, the date of the creation of the image data, and various control numbers assigned to the procedures or image data.

The image data and text data are transmitted over a conventional local area network **40** to a modality interface unit (MIU) **50** in a well known manner. One example of MIU **50** is model number 2223612 made by General Electric Company.

Unit **50** compresses the image data in a well known manner and provides the compressed data, as well as the text data, to an information management server (IMS) **60** via network **40**. One example of IMS **60** is model number 2244014 made by General Electric Company. The text data is stored in a data base in IMS **60**. The compressed image data is transferred by IMS **60** to a short-term memory image storage unit (ISU) **70** which may comprise a RAID unit. RAID units are well known in PACS and need not be described in detail. Although ISU **70** is able to rapidly store data and access such data, its storage capacity is limited. As a result, data stored in ISU **70** frequently is read from ISU **70** by IMS **60** and is transferred via network **40** to a magneto-optical disk (MOD) memory unit **80**. MOD **80** may be arranged as a jukebox managing, for example, 500 disks, each with a capacity of at least 5 gigabytes. Data may be written to and read from MOD memory **80** at a rate of at least 4 megabytes per second, and preferably 5 megabytes per second. One example of MOD **80** is model M-500 made by Plasmon.

In order to provide improved archiving of compressed image data, a digital logic tape (DLT) memory unit **90** is connected to network **40** as shown. DLT **90** provides a tape drive which moves a tape medium on which compressed image data is stored. DLT **90** has a storage capacity of at least 20 gigabytes and preferably 40 gigabytes. Data is written to and read from DLT **90** at a rate of at least 6 megabytes per second and preferably 10 megabytes per second. Examples of DLT **90** include model DLT 7000 made by Quantum and model 9840 made by StorageTek.

During use, at frequent intervals, IMS **60** reads data from ISU **70** and writes the data to DLT **90** via network **40**. As a result, DLT **90** has a data transfer rate at least equal to the data transfer rate of ISU **70**. The ability of DLT **90** to write data read directly from ISU **70** at the same rate as data is written to ISU **90** is an advantage because it reduces the risk that some data will be lost. The applicants have found that employing a tape unit, such as DLT **90**, for this purpose also has cost advantages. Tape units are generally less expensive than RAIDs or magneto-optical units of the same capacity. By providing a tape unit with a data transfer rate as great as the data transfer rate of the ISU enables data to be archived with a degree of safety and economy not previously obtainable. Another advantage of the described system is the use a single server, IMS **60**, to handle data transfers among ISU **70**, MOD **80** and DLT **90**. This arrangement enables a single operating system to be employed which improves software efficiency and reduces costs.

The preferred embodiment also includes conventional medical workstations **100** which create a viewable image on a monitor in response to image data received from any of ISU **70**, MOD **80** or DLT **90**. In response to a request by a user, IMS **60** accesses the desired data on one of ISU **70**, MOD **80** or DLT **90**, decompresses the data, and transfers the decompressed data via network **40** to a designated one of workstations **100**.

Those skilled in the art will recognize the preceding is merely a description of the preferred embodiments which may be altered and modified without departing from the true spirit and scope of the invention as defined in the accompanying claims.

What is claimed is:

1. In a picture archive and communication system comprising a network, apparatus providing communication across said network comprising:

at least one source of medical data, connected to a network, to generate image data and corresponding text data;

a first memory, connected to said network, to receive said image data at a first data rate, and to store said image data;

a second memory, connected to said network, to receive said image data from said first memory at a second data rate before a first capacity of said first memory is exceeded; and

an information management server for storing said corresponding text data and transferring said image data through said information management server from said first memory to said second memory at said second data rate,

wherein said second data rate is higher than said first data rate; and

at least one workstation, connected to said network, to receive said image data and said corresponding text data from said information management server to generate and display an image.

2. Apparatus, as claimed in claim 1, wherein the source of medical data comprises a computed tomography unit.

3. Apparatus, as claimed in claim 1, wherein the source of medical data comprises a magnetic resonance imaging unit.

4. Apparatus, as claimed in claim 1, wherein the network comprises a local area network.

5. Apparatus, as claimed in claim 1, wherein the workstation comprises a monitor.

6. Apparatus, as claimed in claim 1, wherein said first memory comprises a RAID.

7. Apparatus, as claimed in claim 1, wherein said first memory comprises a magneto optical storage unit capable of reading and writing data.

8. Apparatus, as claimed in claim 7, wherein said first memory can read data at a rate of at least 4 megabytes per second.

9. Apparatus, as claimed in claim 1, wherein said second memory comprises a tape storage unit.

10. Apparatus, as claimed in claim 9, wherein said second memory has a storage capacity of at least 20 gigabytes.

11. Apparatus, as claimed in claim 10, wherein said second memory has a transfer rate of at least 6 megabytes per second.

12. Apparatus, as claimed in claim 11, wherein said second memory has a transfer rate of at least 10 megabytes per second.

13. In a picture archive and communication system comprising a network, a method of archiving medical data comprising:

generating medical image data and corresponding text data;

transferring said image data and said corresponding text data over said network;

storing said image data in a first memory on said network at a first data rate;

storing said corresponding text data within an information management server for storing said corresponding text data and transferring said image data through said information management server from said first memory to a second memory at a second data rate,

wherein said second data rate is higher than said first data rate;

transferring said image data from said first memory to a second memory through said information management server;

retrieving said image data from said first memory or said second memory over said network; and

transferring said image data and said corresponding text data over said network for display.

14. A method, as claimed in claim 13, wherein said generating medical image data comprises imaging a patient by computed tomography.

15. A method, as claimed in claim 13, wherein said generating medical image data comprises magnetic resonance imaging.

16. A method, as claimed in claim 13, wherein said storing said image data in said first memory comprises storing said image data at a rate of at least 4 megabytes per second.

17. A method, as claimed in claim 13, wherein said transferring said image data to said second memory comprises moving a tape medium.

18. A method, as claimed in claim 17, wherein said transferring said image data to said second memory comprises providing at least 20 gigabytes of storage.

19. A method, as claimed in claim 18, wherein said transferring said image data to said second memory comprises transferring said image data at a rate of at least 6 megabytes per second.

20. A method, as claimed in claim 18, wherein said transferring said image data to said second memory comprises transferring said image data at a rate of at least 10 megabytes per second.

21. A system for archiving medical data comprising:

a source of medical data including image data and corresponding text data;

a first memory for receiving and storing said image data at a first data rate;

a second memory for receiving and storing said image data at a second data rate; and

an information management server for storing said corresponding text data and transferring said image data through said information management server from said first memory to said second memory at said second data rate,

wherein said second data rate is higher than said first data rate.

* * * * *

US006678764B2

(12) **United States Patent**
Parvulescu et al.

(10) **Patent No.: US 6,678,764 B2**
(45) **Date of Patent: Jan. 13, 2004**

(54) **MEDICAL IMAGE PROCESSING SYSTEM**

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(51) **Int. Cl.**[7] **G06F 13/12**

(52) **U.S. Cl.** **710/65**; 600/407; 707/10; 382/128

(58) **Field of Search** 710/65; 600/407; 707/10

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,920,317 A	*	7/1999	McDonald	345/356
6,188,782 B1	*	2/2001	Le Beux	382/128
6,241,668 B1	*	6/2001	Herzog	600/407
6,529,757 B1	*	3/2003	Patel et al.	600/407
6,574,629 B1	*	6/2003	Cooke, Jr. et al.	707/10

OTHER PUBLICATIONS

"Installation and User Guide" for Sony UP-D70XR, 3 pages, Apr. 10, 200, (See Appendix item #1).

Sony DKR-700 Digital Camera, two Internet Postings, product released in 1997 (See Appendix item #2).

"Stryker Digital Capture", Product data sheet from Internet, Desktop Medical, 1998 (See Appendix item #3).

TEAC MV-180—No published information located (See Appendix item #4 for technical information).

TEAC Viewfile MC-71—Product Specification, two pages, Jun. 2001 (See Appendix item #6).

TEAC MV-300N—Product specification, six pages undated. (See Appendix item #5).

TEAC MV-300P—Product specification, six pages undated. (See Appendix item #5).

Visiplex CCM601—Product specification, two pages, Sep. 1996, (See Appendix item #7).

Visiplex CCM200—Product specification, two pages, 1993, (See Appendix item #7).

Visiplex CCM620—Product specification, one page, undated, (See Appendix item #7).

* cited by examiner

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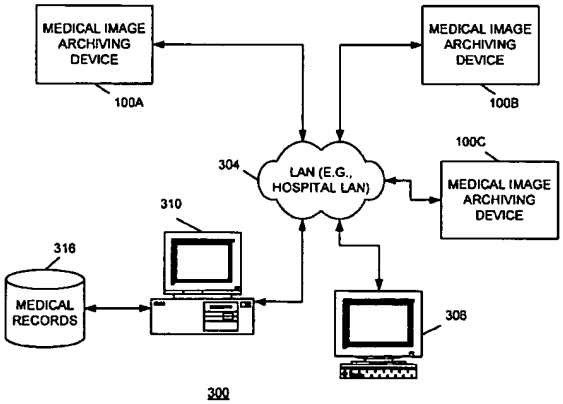
(57) **ABSTRACT**

A medical image archiving system and method. A medical image archiving system receives analog NTSC or PAL video from a medical imaging device and converts it to a digital format for storage. The storage can be via local hard disc drive, or CD writer, or other optical storage medium, or via Local or Wide area network storage to a remote electronic storage medium. The system includes an integral web server to permit easy access over a network using a browser. When an image is stored on a CD, it can be stored as a session and the CD closed to prevent further writing.

21 Claims, 7 Drawing Sheets



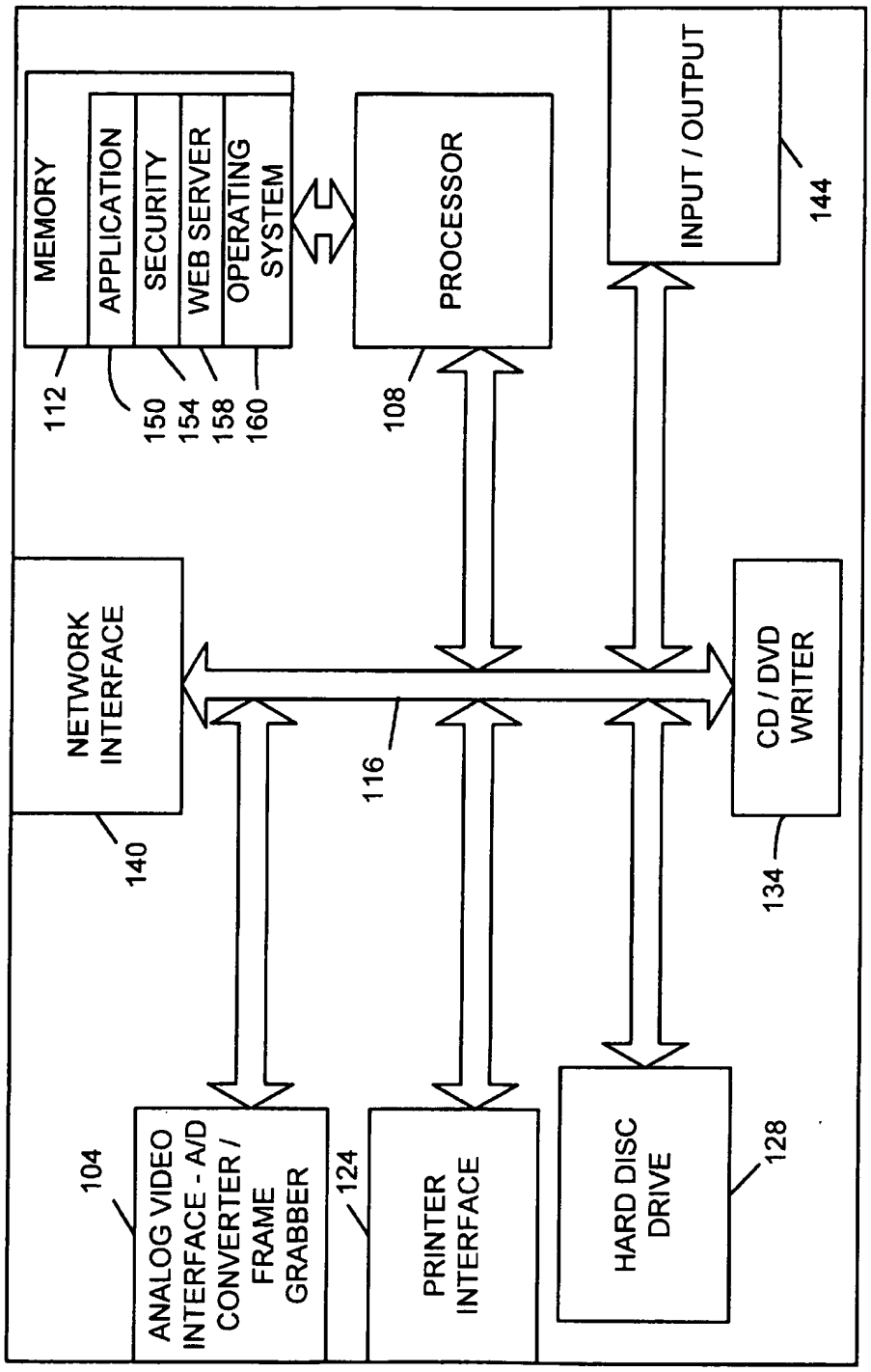
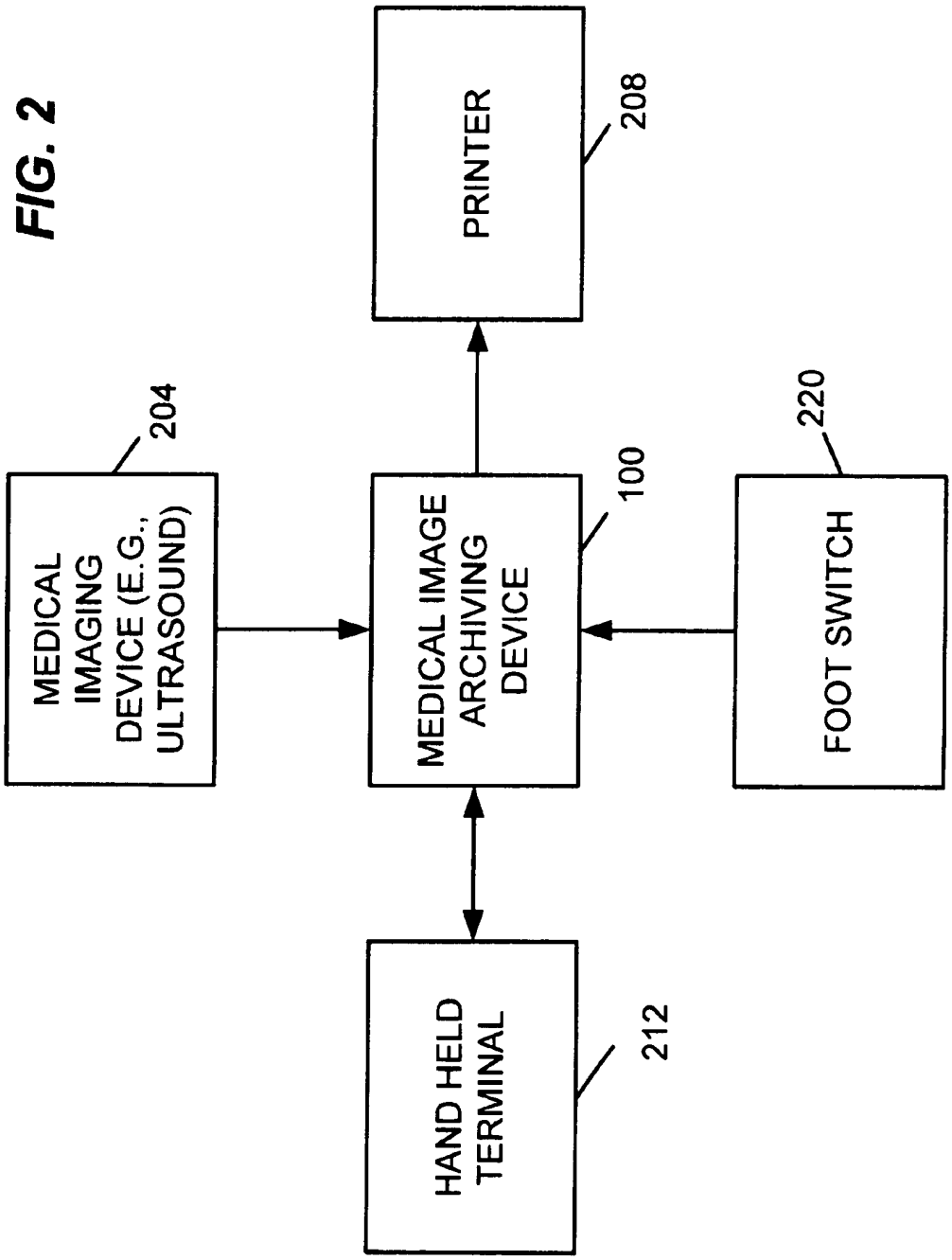

MEMORY
APPLICATION
SECURITY
WEB SERVER
OPERATING SYSTEM
PROCESSOR
INPUT / OUTPUT
NETWORK INTERFACE
CD / DVD WRITER
ANALOG VIDEO INTERFACE - A/D CONVERTER / FRAME GRABBER
PRINTER INTERFACE
HARD DISC DRIVE
112
150
154
158
160
108
144
140
116
134
104
124
128
100

FIG. 1

FIG. 2


PRINTER
208
MEDICAL IMAGING DEVICE (E.G., ULTRASOUND)
204
MEDICAL IMAGE ARCHIVING DEVICE
100
FOOT SWITCH
220
HAND HELD TERMINAL
212

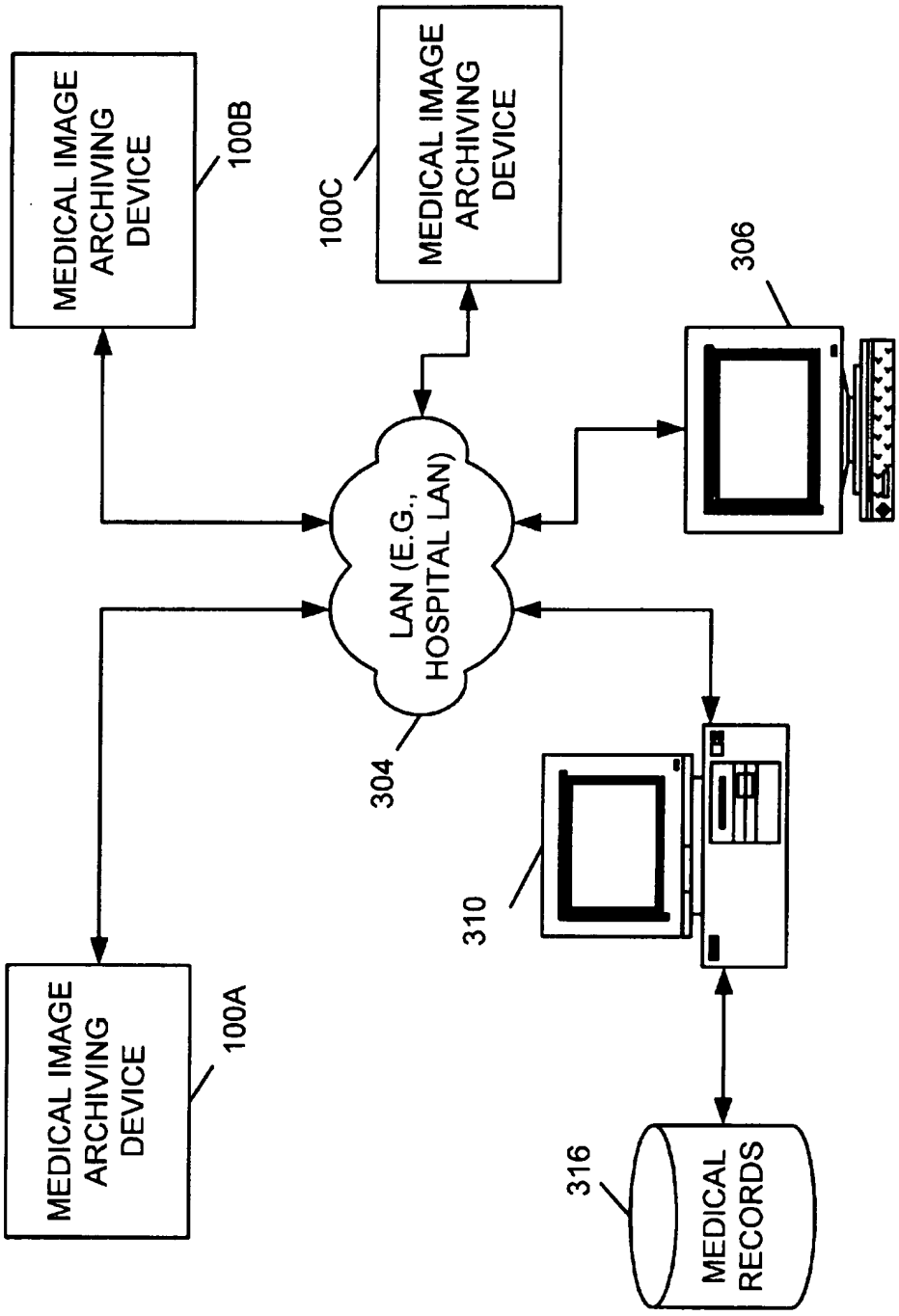

MEDICAL IMAGE ARCHIVING DEVICE
100B
MEDICAL IMAGE ARCHIVING DEVICE
100C
306
LAN (E.G., HOSPITAL LAN)
304
310
MEDICAL IMAGE ARCHIVING DEVICE
100A
316
MEDICAL RECORDS
300

FIG. 3

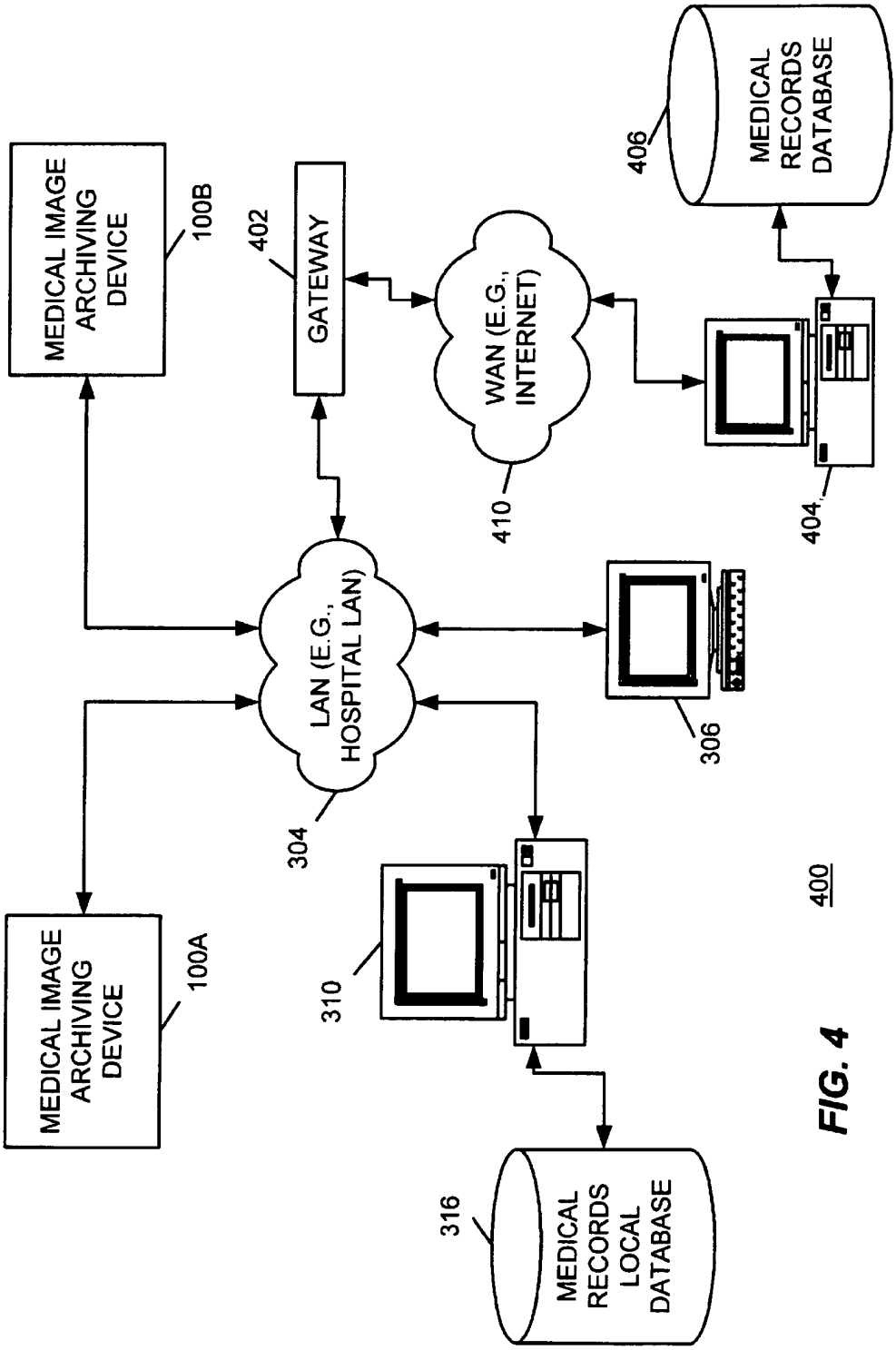
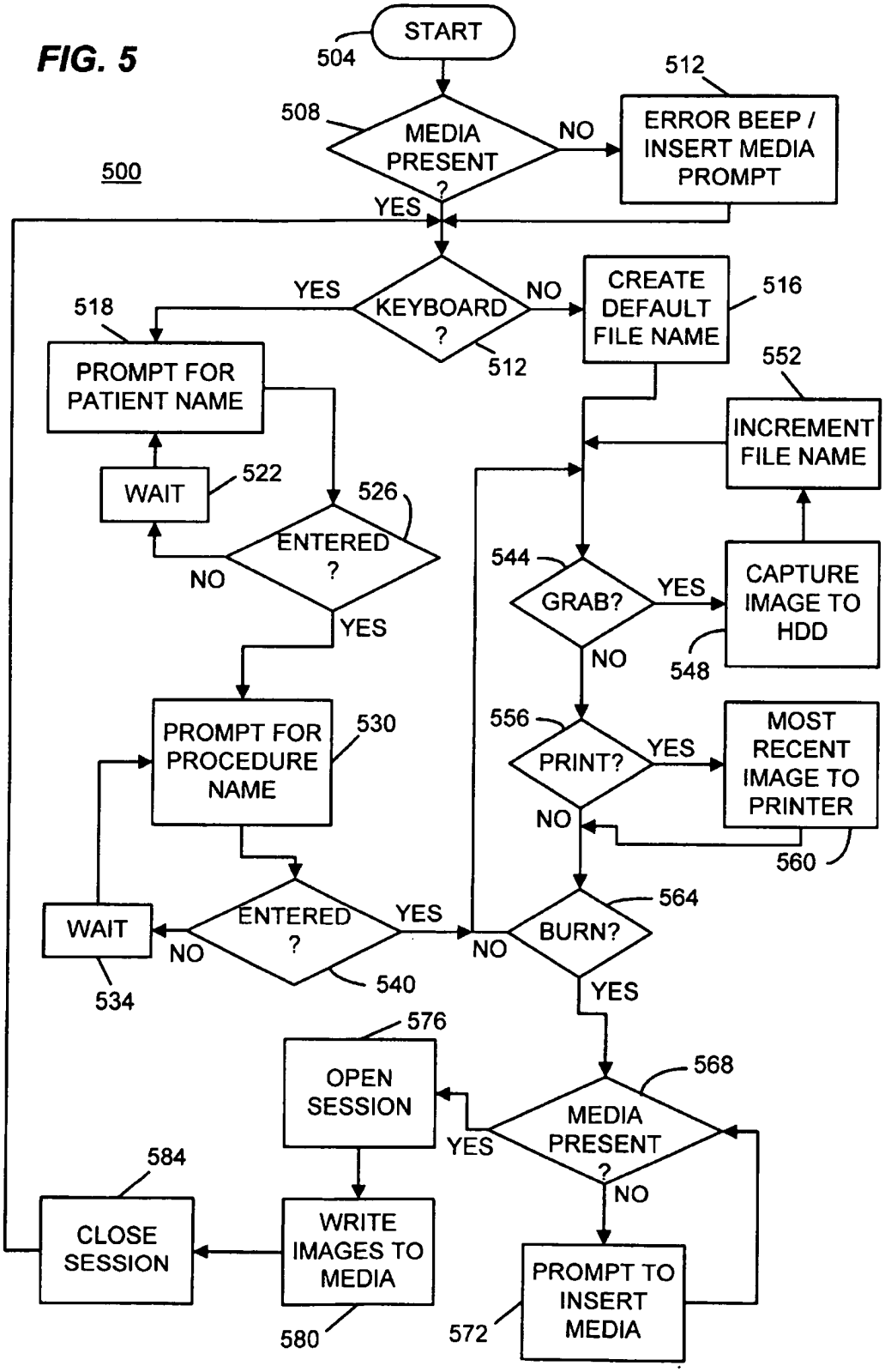

MEDICAL IMAGE ARCHIVING DEVICE
100B
402
GATEWAY
WAN (E.G., INTERNET)
406
MEDICAL RECORDS DATABASE
410
404
LAN (E.G., HOSPITAL LAN)
304
306
MEDICAL IMAGE ARCHIVING DEVICE
100A
310
316
MEDICAL RECORDS LOCAL DATABASE
400

FIG. 4

FIG. 5


500
START
504
MEDIA PRESENT ?
508
NO
ERROR BEEP / INSERT MEDIA PROMPT
512
YES
KEYBOARD ?
YES
NO
512
CREATE DEFAULT FILE NAME
516
518
PROMPT FOR PATIENT NAME
552
INCREMENT FILE NAME
WAIT
522
526
ENTERED ?
NO
YES
544
GRAB?
YES
CAPTURE IMAGE TO HDD
548
NO
PROMPT FOR PROCEDURE NAME
530
556
PRINT?
YES
MOST RECENT IMAGE TO PRINTER
560
NO
WAIT
534
ENTERED ?
NO
YES
540
NO
BURN?
564
YES
576
OPEN SESSION
568
MEDIA PRESENT ?
YES
NO
584
CLOSE SESSION
WRITE IMAGES TO MEDIA
580
PROMPT TO INSERT MEDIA
572

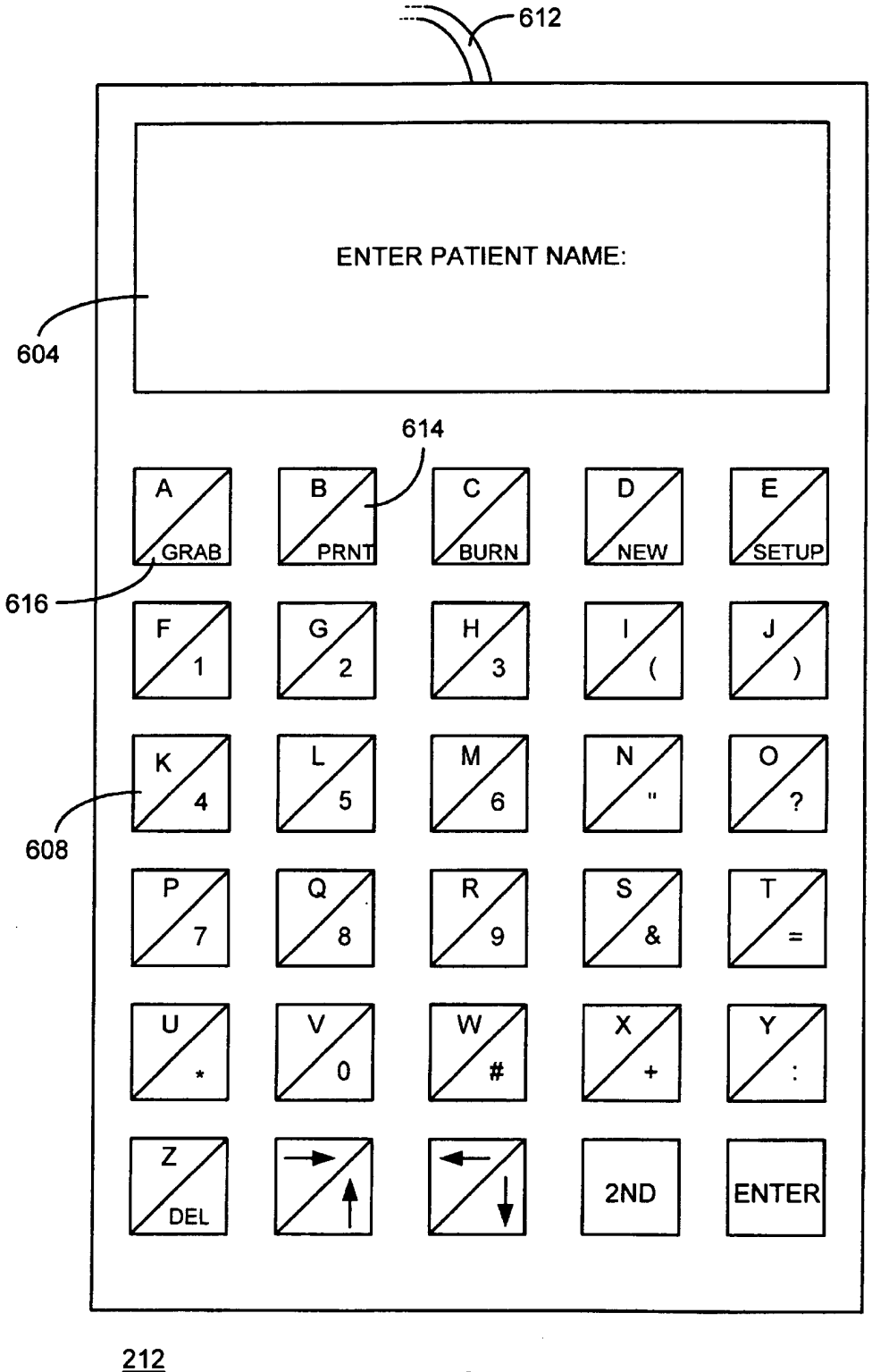

612
ENTER PATIENT NAME:
604
614
A GRAB
B PRNT
C BURN
D NEW
E SETUP
616
F 1
G 2
H 3
I (
J)
K 4
L 5
M 6
N "
O ?
608
P 7
Q 8
R 9
S &
T =
U *
V 0
W #
X +
Y :
Z DEL
2ND
ENTER
212

FIG. 6

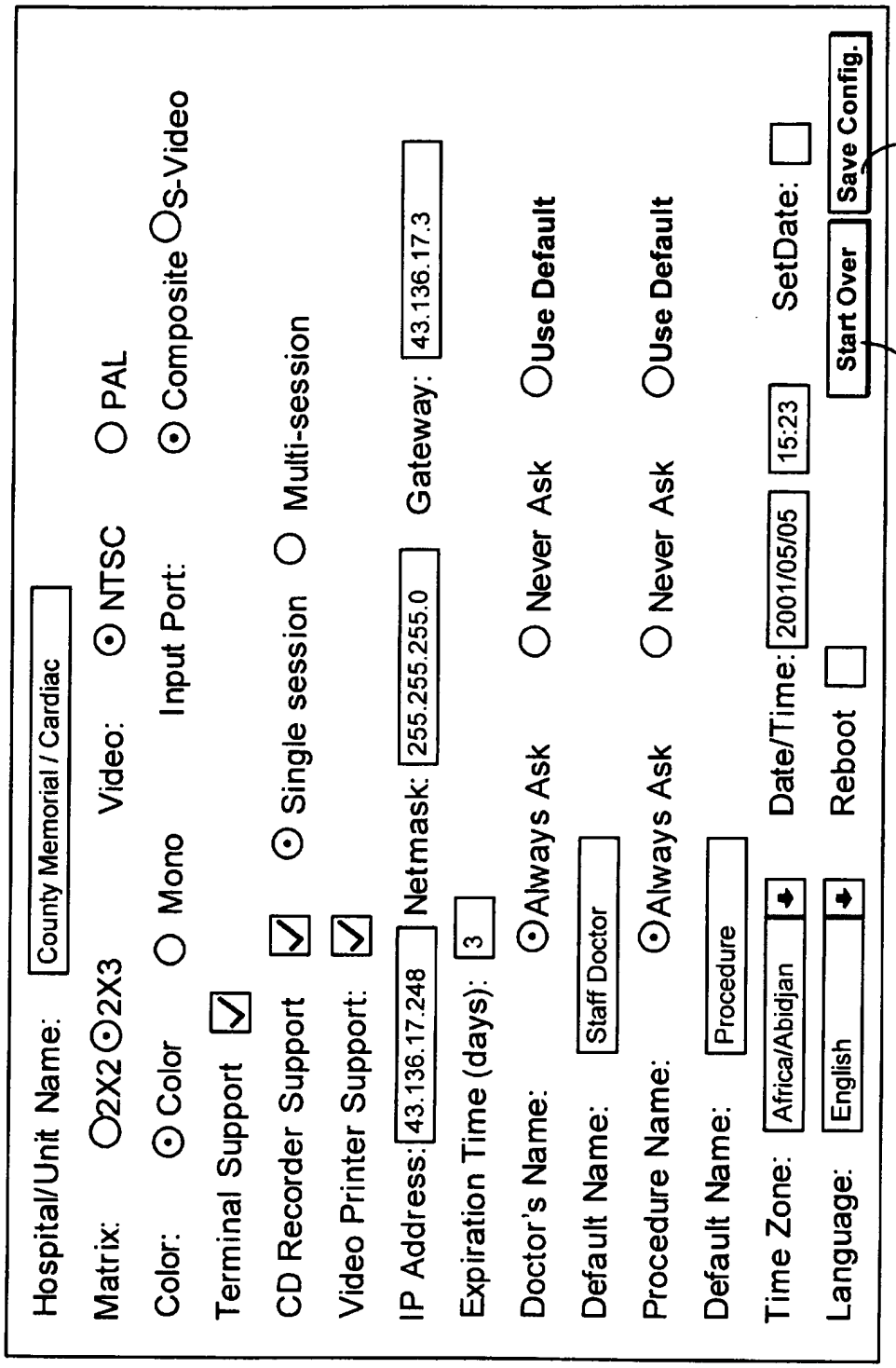

Hospital/Unit Name: County Memorial / Cardiac
Matrix: 2X2 2X3 Video: NTSC PAL
Color: Color Mono Input Port: Composite S-Video
Terminal Support
CD Recorder Support Single session Multi-session
Video Printer Support:
IP Address: 43.136.17.248 Netmask: 255.255.255.0 Gateway: 43.136.17.3
Expiration Time (days): 3
Doctor's Name: Always Ask Never Ask Use Default
Default Name: Staff Doctor
Procedure Name: Always Ask Never Ask Use Default
Default Name: Procedure
Time Zone: Africa/Abidjan Date/Time: 2001/05/05 15:23 SetDate:
Language: English Reboot
Start Over
Save Config.
700
704
708

FIG. 7

MEDICAL IMAGE PROCESSING SYSTEM

This application claims the benefit of provisional application Ser. No. 60/241,948 filed Oct. 20, 2000.

FIELD OF THE INVENTION

This invention relates generally to medical image systems, and more particularly to a medical image archiving and information exchange system, with image management features.

BACKGROUND OF THE INVENTION

The medical community currently relies heavily upon a large installed base of tens of thousands of analog medical imaging devices (for example, ultrasound imaging devices) that provide no inherent capability to provide persistent storage of the images produced. Additional hardware is required to produce persistent images. Some of the most prevalent of such hardware are devices using a camera and a CRT display coupled by an optical system. The user sends analog video signals to this device and the device produces a hard copy in the form of an x-ray type picture or photo quality print of images made by the imaging device. This camera-type imager contains a conventional film camera mechanism. This camera mechanism inside the camera imager is moved mechanically to produce formats of 1, 4, 6, or 9 images on a single sheet of film. The film is then processed using an X-ray film processor so that the resultant hard copy image can be made a part of a patient's paper medical records. To utilize such a system requires the camera imager, the auto X-ray film processor, and the chemicals for the developer and the fixer, which require constant replenishment. This system does not provide for ready electronic storage and transfer of the images for convenient archiving or for rapid and convenient examination by a consulting physician located in a distant part of a hospital or even in another city. Moreover, the system requires technical skills in developing the resulting images, and has proven expensive to use and maintain. Such devices are commercially available.

Several other devices have been used in the marketplace to capture images on paper or on proprietary electronic media, but none have proven very commercially successful. Proposed standards such as HIPPA (Health Insurance Portability and Accountability Act) are likely to place strict requirements on the archiving of medical records in the near future. This places a substantial burden on hospitals, clinics and doctors which may not be adequately met with current archiving systems.

SUMMARY OF THE INVENTION

The present invention relates generally to medical imaging. Objects, advantages and features of the invention will become apparent to those skilled in the art upon consideration of the following detailed description of the invention.

In one embodiment of the present invention, a medical image archiving system and method is provided. A medical image archiving system receives analog NTSC or PAL video from a medical imaging device and converts it to a digital format for storage. The storage can be via local hard disc drive, or CD writer, or other optical storage medium, or via Local or Wide area network storage to a remote electronic storage medium. The system includes an integral web server to permit easy access over a network using a browser. When an image is stored on a CD, it can be stored as a session and the CD closed to prevent further writing.

A medical imaging method consistent with an embodiment of the present invention includes receiving an analog video input signal from a medical imaging device; converting a frame of the analog video input signal to a digital representation; assigning a file name to the digital representation; storing the digital representation on a disc drive; and storing the digital representation as a part of a session on an optical storage medium.

A medical image archiving device, consistent with an embodiment of the present invention includes a frame grabber that receives an analog video image from a medical imaging device and produces a digitized still image in response to a command. A programmed processor is connected to a network interface adapter that interfaces the processor to an electronic communication network. A web server application runs on the programmed processor, the web server having an IP address associated therewith. A disc drive stores the digitized still image. An application program running on the programmed processor receives a request directed to the IP address for the digitized still image from the network via the network interface adapter, and generates a reply transmitting the digitized image to an IP address associated with the request.

A storage medium consistent with an embodiment of the invention stores instructions which, when executed on a programmed processor, carry out a process of: receiving an analog video input signal from a medical imaging device; converting a frame of the analog video input signal to a digital representation; assigning a file name to the digital representation; storing the digital representation on a disc drive; and storing the digital representation as a part of a session on an optical storage medium. In one variation, the the digital representation is transmitted over either a wide area network or a local area network.

The above summaries are intended to illustrate exemplary embodiments of the invention, which will be best understood in conjunction with the detailed description to follow, and are not intended to limit the scope of the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the invention believed to be novel are set forth with particularity in the appended claims. The invention itself however, both as to organization and method of operation, together with objects and advantages thereof, may be best understood by reference to the following detailed description of the invention, which describes certain exemplary embodiments of the invention, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a block diagram of a medical image archiving device consistent with an embodiment of the present invention.

FIG. 2 illustrates a first exemplary system consistent with an embodiment of the present invention.

FIG. 3 illustrates a second exemplary system consistent with an embodiment of the present invention, using a hospital LAN including multiple image archiving devices connected to a server.

FIG. 4 illustrates a third exemplary system consistent with an embodiment of the present invention, in which a hospital server is connected to a records managing server through a public network such as the Internet.

FIG. 5 is a flow chart illustrating an operational mode consistent with an embodiment of the present with a CD or DVD writer drive attached.

FIG. 6 is an illustration of a hand-held terminal suitable for use with an embodiment of the present invention.

FIG. 7 illustrates an exemplary setup screen used in one embodiment consistent with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail specific embodiments, with the understanding that the present disclosure is to be considered as an example of the principles of the invention and not intended to limit the invention to the specific embodiments shown and described. In the description below, like reference numerals are used to describe the same, similar or corresponding parts in the several views of the drawings.

Turning now to FIG. 1, a medical image archiving device **100** that can be used as a part of a system to capture video images is illustrated. Once the images are generated in analog form by the medical imaging device, they can be readily converted to digital form by the current medical image archiving device **100** and archived to any suitable local or remote electronic storage medium, transferred to a remote display via a local or wide area network (including the Internet) or printed as required. Operation of the device will be best understood upon consideration of the discussions of the possible system environments to be described later. Device **100** accepts a conventional analog output (e.g., from an ultrasound imaging device) at an interface **104**. This interface may receive, for example, NTSC or PAL formatted analog video signals from a medical imaging device such as an ultrasound machine and convert them to a digital format using an analog to digital converter under the control of a processor **108** (e.g., a PC based computer processor having associated memory **112**). A digitally encoded still image is made available to a system bus **116** by the hardware or software based frame grabber forming a part of interface **104**.

On instruction from processor **108**, the image captured by the frame grabber of **104** can be output to a printer via a printer interface **124**, or stored on a hard disc drive **128** or a writeable CD ROM or DVD via CD or DVD writer (media writer) **134**. In alternative embodiments the media writer **134** may be provided externally to device **100** using, for example, a SCSI interface that can be used to interface to any suitable storage medium. The image can also be sent to other locations via a network interface **140** (e.g., a standard PC Ethernet interface card). Input commands from a user can be received via conventional input devices such as a footswitch, keyboard, hand held terminal, front panel controls, mouse, etc. connected to the input/output interface **144** in a conventional manner. Various conventional recordable CD drives may be used in conjunction with the image archiving device, such as a Sony™ CRX-160-E, Sony Corporation, Tokyo, Japan.

Preferably, the image signal is received at the interface **104** as a conventional (e.g., NTSC or PAL) video signal output by a conventional medical imaging device, such as an ultrasound scanning device or operating room endoscope that displays on a CRT using NTSC standards or the like. Optionally, an RGB or other analog format input may be accommodated. In one embodiment, a MATROX Meteor-II™ video capture board, as manufactured by Matrox Electronic Systems, 1055 St. Regis, Dorsal, Quebec, Canada H9P 2T4 may be used to implement the video capture functionality of interface **104**. The medical image archiving device **100** captures a still image frame corresponding to the incoming video stream using the frame grabber of interface **104**, and then converts the grabbed frame into a digital format under the control of processor **108**. Such conversion may take place in the frame grabber interface board **104** or may be carried out by processor **108** under program control. Preferably, the .tif format is used, however, other formats could equally well be used, such as the DICOM (digital imaging and communications in medicine) format without departing from the invention. Depending upon input instructions, the grabbed and formatted image can then be stored on a local hard disc drive **128** (e.g., a 60 GB hard disc drive), recorded on a writable compact disc or the like at **134**, printed via printer interface **124**, or transmitted to other nodes on any network to which the device is connected via the network interface **140**.

The processor **108** carries out instructions stored in memory **112** of an application **150** as will be described later. Memory **112** also stores security applications **154**, a web server **158** and an operating system **160**. In addition, working memory is available for use by the processor **108** to facilitate operation in a known manner.

Referring now to FIG. 2 a first exemplary system **200** consistent with an embodiment of the present invention is illustrated including the image archiving device **100** connected to a medical imaging device **204** (e.g., an ultrasound device), a printer **210**, a hand held terminal **212**, and footswitch **220**.

The medical image archiving device **100** uses an embedded PC based on processor **108** as a control processor to provide the following functionality. The medical image archiving device **100** receives an analog signal from the image capture device **204**, stores the image in digital form at the internal hard disc drive **128** (perhaps temporarily) and outputs corresponding digital signals to the media writer **134** and the printer **210**. The medical image archiving device **100** also receives image capturing and storing commands, preferably from a simplified foot operated device such as a three button serial footswitch **220**, but may instead or in addition to the footswitch **220** utilize a keyboard and/or a display device, or hand held terminal **212** to facilitate input. Utilizing this functionality, the medical image archiving device **100** permits the user to capture the images (e.g., ultrasound images), print them using a high quality printer **210**, record the images on a non-volatile storage medium such as a CD-R or DVD to facilitate organization, management and archiving of the images. Preferably, images stored on a CD are stored as a session with the CD being closed after writing the session to prevent further writing on the CD.

In accordance with a preferred embodiment, the stored images are indexed via a predictable syntax, whether the user enters specific information via a keyboard or hand held terminal **212** (e.g., patient and doctor names), or uses the image archiving device **100** without the keyboard or terminal **212**. Use of a predictable syntax eases future management and retrieval of the images. In accordance with certain embodiments, if the user chooses not to have the keyboard or terminal **212** connected to the system, an "automatic indexing" mode is used.

The pictures are stored on the image archiving device **100**'s local hard disc drive **128** in a "session" format, one patient name being attached to a session. The sessions may be kept on local storage for any suitable period of time (e.g., 4 or 72 hours selectable) or until a user chooses to manually erase them. At convenient times (e.g., nightly) or at periodic intervals (e.g., every 72 hours erased and the disc storage

freed for subsequent operation (e.g., the following morning). Preferably, the pictures will have been backed up onto a system server or other persistent storage prior to freeing the local storage.

Referring now to FIG. **3**, an exemplary system **300** is illustrated using a hospital LAN **304** used to network a plurality of medical image archiving systems **100A**, **100B** and **100C** connected to various client terminal devices **306** and as well as a server **310** serving as a repository for a database of medical records **316**. In such a system, medical records can be centrally stored in server **310**'s database **316** with input from any of the medical image archiving devices **100A**, **100B** and **100C** periodically contributing to the storehouse of information. Any of this information may be retrieved at any time from a client workstation **306** or other appropriately connected viewing device connected to the LAN **304** for immediate access to the information. In this manner, consulting physicians can view images from their office, a library or any other convenient location having access to the hospital LAN **304** to provide more rapid and efficient viewing. Since the medical image archiving devices each incorporate the software that implements a web server, each has an IP address that can be used from any terminal to access the data stored on the disc drive **128** thereof using any suitable browser software.

FIG. **4** illustrates a third exemplary system consistent with an embodiment of the present invention, in which the hospital server **310** is connected via a gateway **402** to a records managing server **404** having a medical records database **406** through a public or private network **410** such as the Internet. In this embodiment, preferably, the hospital LAN **304** implements a web server. Pictures stored on the image archiving device hard disc drive **128** can be reviewed remotely via a TCP/IP connection, using a regular browser. Thus, an expert physician, technician or researcher in another city can be provided with access to view a particular patient's images (either on the local database **316** or on the medical image archiving devices **100A** or **100B**) without need for delays associated with mailing hard copy records for review. Security software **154**, such as that commercially available from Verisign, 1350 Charleston Road, Mountain View, Calif. 94043 or others can be used to control access to the images. Pictures can be automatically downloaded and stored at the remotely located medical records management server **404** during evening hours or the like, before freeing the local storage as described above.

Additionally, the embodiment of FIG. **4** provides an easy way to dynamically setup the image archiving device **100**. The settings for the device can be made directly upon set up, using the optional keyboard/LCD. Alternatively, the settings can be remotely provided at the hospital server **310**, client node **306** or any other appropriate node, using a browser based interface, such as the commercially available Netscape Navigator™, from Netscape, 466 Ellis Street, Mountain View, Calif. 94043 or other browser software. The selectable settings in this embodiment include IP address, hospital/practice name, and storage length, and backup characteristics. Preferably, the medical image archiving device also includes a non-volatile flash memory forming a part of memory **112** that stores settings information. In addition to initialization, maintenance can be performed remotely via the network or the web.

Preferably, the hardware platform of the image archiving device includes a bookshelf type housing having a footprint of approximately 12"×12"; a conventional medical grade power supply; an Intel Pentium™ class processor (e.g., a processor compatible with and preferably having at least the processing power of an Intel Celeron™ 333 MHz microprocessor, available from Intel Corporation, Santa Clara, Calif.); 2 PCI expansion slots; one exposed bay for the recording device **216** (e.g., CD-R, CD-RW or DVD+RW (ATAPI)); hard drive **128** (e.g. 10 Gb); 32 Mb of RAM; a preferably 60 GB or greater hard disc drive; a network interface **140** (e.g. fast Ethernet); a conventional video based capture board including composite and Y/C inputs forming interface **104** and frame grabber interface card **104**; and a SCSI interface card. Other configurations could also be used without departing from the present invention. For example, in another embodiment, all parts could be integrated into a single circuit board rather than using standard PC components.

The image archiving device **100** can be implemented using any suitable operating system. In the preferred embodiment, the Linux operating system is used to minimize cost by operating in a license free environment. The Linux system (e.g., Red Hat Linux version 6.0 or later, available from Red Hat, Inc., 2600 Meridian Parkway, Durham, N.C. 27713, running in a minimal configuration) can provide multitasking abilities and device support for the CD-burner and the video capture device. Although various additional components may be provided where space and or cost limitations are not present, the basic level image archiving device **100** need not necessarily require a display adapter (VGA), keyboard, network, or a floppy disc drive.

Preferably, much of the functionality of capturing, storing, writing, printing and communicating with other network nodes is provided by software, but hardware could also provide certain of the functionality. Generally the software modules would run on the Linux Operating system (e.g. Red Hat 6.0, minimum configuration), as described above. The software used in the present system can be broken into several modules. The operating system module may be embodied as Standard Red Hat Linux 6.0 (minimum configuration), and Linux printing subsystem (lpd, lpr, lpq, etc . . .), for example. The main application module is responsible for monitoring the user input device (serial smart footswitch), triggering the frame grabber to catch the current image, printing in multiple formats (single image, 4 on 1, and 6 on 1—on single sheet), and transferring the image to the print subsystem for processing. A frame grabbing module incorporating a frame grabber device driver that drives the frame grabber board is used by the image archiving device **100** to handle image capture, and storage along with user interface functions. A footswitch module receives input from a smart footswitch connected via a keyboard interface. Preferably, three different events are triggered by the footswitch, although various configurations may be realized. The three events in one embodiment could be "grab image," "store image" and "print image." The software system may also include a copy protection module, a printer driver for any suitable printer such as the Sony™ printer UPD-70XR (SCSI and parallel). The printer driver integrates into the Linux printing subsystem, making the spooling and printing of the images transparent to the application. The software may also include a CD-R/W writing module that controls the function of a CD writer.

Referring now to FIG. **5**, a process for operation of the image archiving device **100** with an attached CD writer **134** is described starting at **504**. As part of an initialization process, a specific memory location is inspected where a hospital name/practice name should be kept. If this location is empty then the image archiving device **100** issues a warning sound (e.g., long beeps) and waits for a user to carry out a setup procedure. At this time a regular keyboard and

computer display, or hand held terminal **212** should be attached either directly or via a network connection, according to the present embodiment, and the user should follow the instructions on the screen to perform the setup (hospital/practice name, date and time, IP address, etc.). At any time, the user can change the settings by connecting a regular PC keyboard and monitor and repeating the above setting procedure. This allows the user to change the names or the IP address in order to fit the needs. The setup can also be performed through the network from a terminal or server using the connection described above.

After the initialization process, the software checks for the presence of media (e.g., CD-R) in the media writer **134** at **508**. If media is not present, a beep or other warning and prompt to the user to insert the media is issued at **512**. If media is detected at **508**, control passes to **512**. The software checks at **512** for an installed keyboard and display or hand held terminal on a serial or keyboard port at **512**. In accordance with one embodiment, a file name system is created by the software according to a default process at **516** if no input device is present at **512**. If a keyboard or other input device is detected at **512**, the user is prompted for a patient name at **518**. The software then waits at **522** until the name is entered at **526**. Once entered, the software prompts the user for the procedure name at **530** and waits at **534** until the name is entered at **540**. Control then passes to **544** from either **540** or **516** to await the input (e.g., from a three switch foot switch **220**) for commands to grab an image, print an image or burn a CD (or otherwise record to the media. In other embodiments, the user can be prompted for any information desired for creation of a file name.

According to the preferred embodiment, the file name is created from the operator input for patient name, followed by a sequential number (starting from number 001), a fixed hospital or practice name, time and date, optional operator keyboard input for performed procedure and a standard file extension at **528**. Of course, other formats can be used without departing from the invention, and other information can be obtained by user input besides that explicitly described above. The template for the file name for this embodiment is:

"<Patient name>_<sequential image number >_<Hospital/practice name>_hh-mn-mm-dd-yyyy_<Optional Procedure>.tif"
Example:
"John Smith_001_St.George's Hospital_18-05-02-12-1997_kidney.tif"
The next image for the same patient might be:
"John Smith_002_St.George's Hospital_18-08-02-12-1997_kidney.tif"
The first image for the second patient:
"O'Connell Terry_001_St.George's Hospital_18-17-02-12-1997_knee.tif"

In the event a keyboard is not detected at **512**, the file name is created according to a default algorithm at **516**. In the preferred embodiment, the file name will start with a <Patient-001> followed by <sequential image number>, <Hospital/practice name>, <time and date> and a standard file extension. Since the operator will not input names, a default patient name is used. The default patient name in this embodiment is "Patient-001". The next patient name will be "Patient-002" and so on. At the end of the day, after cleaning up the buffer (hard disc drive **128**), the default patient name may be reset to "Patient-001" in one embodiment or continue sequentially in others. Of course, other naming conventions can also be used without departing from the invention. The template for the present file naming convention is:

"<<Patient-001>_<sequential image number>_<Hospital/practice name>_<hh-mn-mm-dd-yyyy>.tif"
Example:
"Patient-001_001_St.George's Hospital_12-35-02-12-2000.tif"
The next image for the same patient will be:
"Patient-001_002_St.George's Hospital_12-40-02-12-2000.tif"
The first image for the second patient:
"Patient-002_001_St.George's Hospital_12-45-02-12-2000.tif"

The file names in the preferred embodiment should not exceed 256 characters including sequential number, hospital name, time stamp and procedure, but this should not be considered limiting. If the operator inputs more then 256 characters in this embodiment, input will be truncated in such a way that sequential number, hospital name and patient name will be kept intact. (Discarding characters from operator input to keep file name up to 256 characters).

At **544**, if a grab command is received (e.g., by foot switch operation), the image from the imaging device is captured (grabbed) and saved to the hard disc drive **128** at **548**. The file name is incremented at **552** and the software again awaits a foot switch or other input. If a Grab command is not received and the Print command is received at **556**, then the most recently grabbed image is appropriately formatted and labeled and sent to the printer at **560**. If a Burn command is received at **564**, the software again inspects the media writer **134** for the presence of valid media. If there is no media present at **568** or the media is for some reason invalid or otherwise unusable, an error message is generated, preferably including a prompt to insert valid media at **572**. In the case of a writeable CD, the images are written as a session. When valid media is detected at **568**, a new session is opened on the CD at **576**, the session is written at **580** and the session is closed at **584** and the media ejected. Similar processes can be used for other media. The process then returns to **512** to await the next imaging session. This embodiment assumes that the session is written as a batch. In other embodiments, the session can be written as the images are taken without departing from the invention.

If a valid blank CD is present at **568**, the CD driver software module carries out the task of preparing the CD image on the hard drive into a standard ISO9660 file format required by the CD-R burning software (or any appropriate file format for writing on DVD+RW). The CD image is burned into the CD-R in single session mode, also known as CD-ROM mode-1 (or any appropriate file format for writing on DVD+RW). At the end of the write operation when the last image has been written the disk is "closed" not allowing any more sessions on the same media, and the media is ejected from the drive.

If the user presses the eject button or the unit is powered down while writing is in progress then the CD image remains on the hard disc drive **128** as well as the original images. At the next power up an audible signal warns the operator that a CD image is waiting to be transfer to the CD-R drive. At this time the operator can insert a blank disk in the drive and press an appropriate key to cause the CD image to be written to the CD-R. The operator can choose to ignore this warning by operating the unit in a usual manner; for example, input new patient name, and start capturing new images. In this case the unwritten CD image will be kept on the hard drive until the next hard drive clean up. Other error trapping can also be implemented without departing from the invention, however, the embodiment illustrated in FIG. **5** has been simplified to minimize such error trapping and other details so as not to obscure the invention.

The captured .tif or DICOM (or other format) images may be variously manipulated for printing, preferably to provide 1, 4, 6 or 9 image prints per page. One preferred printer is the Sony™ UP-D70XR photo-realistic printer—available commercially from Sony Corporation, Tokyo, Japan, which provides full letter-sized printing capabilities for various medical and scientific applications. The UP-D70XR includes a 300 dpi thermal head that prints in color images in approximately 55 seconds and transparency images in approximately 45 seconds. A gray balance calibrating function allows users to set the ideal gray balance for color accurate images. The print area covers up to 8"×10" on letter-size paper and full-bleed on A4+paper. The UP-D70XR includes SCSI and Centronics interface for connection to the image archiving device. For DICOM format, the UPA-D3 Digital Print Server can be used with this printer, and can communicate with the printer over the hospital LAN using TCP/IP. Of course, any suitable printer can be used without departing from the present invention.

The image archiving device **100** of the preferred embodiment has either a default "doctor" name, or has facilities for receiving doctor's names such as via a keyboard. The file directory organizes records into files denoted by the name of the doctor performing the procedure. So, if Doctor Gooden is performing the procedures on patient John Doe, then the captured images are stored in a folder called "Gooden", with each file in the folder incorporating a standard syntax including the patient's name, image number, hospital/practice name, time & date, and procedure information as described above. Thus, a doctor's files are easily located, as they are all stored together in a unique file.

In the network environment, with the browser based functionality as described above, various records can be easily accessed and managed, and the records can further be organized according to the above described syntax. That is, the records for a given doctor could be browsed, and HTML links to the individual files, for remote viewing, downloading and the like are readily provided. By virtue of the medical image archiving device being equipped with a web server, the device can be addressed by its IP address, queried to request a stored image, and transmit the stored image to an IP address associated with the request.

The described file storage syntax could be modified by the hospital or another entity. For example, each patient may be assigned a unique identifier, which might follow the patient as they receive treatment at various institutions. The medical records management server could store all of the records for that individual using the unique identifier. Alternatively, the medical records management server might provide a search engine for finding records based upon information such as the patient name, doctor name, hospital name, date, etc.

Referring now to FIG. **6**, an exemplary hand held terminal is illustrated. The terminal includes a small display **604** (e.g., an LCD display panel) with large enough resolution to permit display of all needed prompts and user inputs. Scrolling can be used if needed to facilitate display of prompts and user input. An array of input keys such as alpha-numeric key **608** is also provided to permit entry of text and numerical data. In one embodiment, specific function keys such as a "print" key **614** and a "grab" key **616** may be provided. In other embodiment, generic function keys (F1, F2, . . .) are used. The hand held terminal **212** may be connected to the medical image archiving device **100** by a cable **612** or using infrared or other communications as will be evident to those skilled in the art. The specific keyboard layout shown is intended only to be exemplary and should not be considered limiting. Other terminal configurations can also be used.

FIG. **7** shows an exemplary setup screen used in the preferred embodiment of the invention. In this screen, various default and system parameters are entered and stored in flash memory, or other non-volatile storage for use by the device **100**. When the medical image archiving device **100** is turned on for the first time, or when a specified command is issued to initiate a setup, a setup screen such as screen **700** appears. Screen **700** is created, in one embodiment, using HTML and is displayed using a browser. In a network embodiment, the setup screen can be displayed and completed from a remote terminal device such as **306**. In this screen **700**, the user can enter the number of prints per page (in this embodiment 2×2 or 2×3) and the type of video format being received. The user also selects the type of display (color or monochrome) and the input port being used (composite or S-Video).

The user can also select whether or not a terminal such as hand held terminal **212** is to be used or not and whether a CD Recorder is being supported (in either single session or Multi-session formats). The user also selects whether or not a printer is connected. In a networked situation, IP address, Netmask and Gateway identifiers are entered to permit communication over the network. The amount of time a file can remain on the hard disc drive **128** until purged can be entered as well as default procedure and doctor names. Whether or not the default names are used or whether the user is queried for names when used is entered also. The screen **700** also permits entry of date, time and time zone as well as language support. The user can also elect to set the date or reboot when the configuration is saved using the save configuration button **704**. Errors can be corrected by starting over using start over button **708**. Of course, those skilled in the art will understand that the screen **700** is intended to be exemplary and many variations and enhancements are possible within the scope of the present invention.

This invention allows those using analog imaging devices without storage and/or printing facilities to upgrade at reasonable cost to digital image archiving and managing operations and/or to implement convenient digital image back up storage and easy transportability of the image over local or wide area networks including the Internet. The invention also obviates the need for wet processing of silver halide film and the corresponding chemistry for production of printed images, making it an environmentally friendly and cost effective solution.

Those skilled in the art will recognize that the present invention has been described in terms of exemplary embodiments based upon use of a programmed processor. However, the invention should not be so limited, since the present invention could be implemented using hardware component equivalents such as special purpose hardware and/or dedicated processors which are equivalents to the invention as described and claimed. Similarly, general purpose computers, microprocessor based computers, microcontrollers, optical computers, analog computers, dedicated processors and/or dedicated hard wired logic may be used to construct alternative equivalent embodiments of the present invention.

Those skilled in the art will appreciate that the program steps used to implement the embodiments described above can be implemented using disc storage as well as other forms of storage including Read Only Memory (ROM) devices, Random Access Memory (RAM) devices; optical storage elements, magnetic storage elements, magneto-optical storage elements, flash memory, core memory and/or other equivalent storage technologies without departing from the present invention. Such alternative storage devices should be considered equivalents.

The present invention is preferably implemented using a programmed processor executing programming instructions that are broadly described above in flow chart form and can be stored on any suitable electronic storage medium. However, those skilled in the art will appreciate that the processes described above can be implemented in any number of variations and in many suitable programming languages without departing from the present invention. For example, the order of certain operations carried out can often be varied, and additional operations can be added without departing from the invention. Error trapping can be added and/or enhanced and variations can be made in user interface and information presentation without departing from the present invention. Such variations are contemplated and considered equivalent.

While the invention has been described in conjunction with specific embodiments, it is evident that many alternatives, modifications, permutations and variations will become apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended that the present invention embrace all such alternatives, modifications and variations as fall within the scope of the appended claims.

What is claimed is:

1. A medical imaging method in a medical image archiving device, comprising:

sending a prompt for image identification information to a hand held terminal;

receiving the image identification information from the hand held terminal;

receiving a grab image command from one of a footswitch and the hand held terminal;

receiving an analog video input signal from a medical imaging device;

converting a frame of the analog video input signal to a digital representation within the image archiving device in response to receiving the grab image command from one of the footswitch and the hand held terminal;

receiving a store image command from one of the footswitch and the hand held terminal;

assigning a file name to the digital representation based on the image identification information;

storing the digital representation on a disc drive;

receiving a burn CD command from one of the footswitch and the hand held terminal: and

storing the digital representation as a part of a session on an optical storage medium.

2. The method according to claim **1**, further transmitting the digital representation over a communication network to an IP address.

3. The method according to claim **1**, further comprising transmitting the digital representation over a local area network to an electronic storage device.

4. The method according to claim **1**, further comprising transmitting the digital representation over a wide area network to an electronic storage device.

5. The method according to claim **4**, wherein the wide area network comprises the Internet.

6. The method according to claim **1**, wherein the digital representation comprises one of a .tiff format digital representation and a DICOM (digital imaging and communications in medicine) format digital representation.

7. The method according to claim **1**, wherein the analog video input signal is formatted in one of PAL and NTSC format video.

8. The method according to claim **1**, further comprising detecting whether the hand held terminal is available, and assigning a default file name if the hand held terminal is not present.

9. The method according to claim **8**, further comprising generating assigning a default file name if no input device is available.

10. A medical image archiving system, comprising:

a footswitch;

a hand held terminal; and

a medical image archiving device, comprising:

an interface for attaching the footswitch;

an interface for attaching the hand held terminal;

a frame grabber receiving an analog video image from a medical imaging device and producing a digitized still image in response to a grab image command from one of the footswitch and the hand held terminal;

a programmed processor;

a network interface adapter that interfaces the processor to an electronic communication network;

a web server application running on the programmed processor, the web server having an IP address associated therewith;

a disc drive that stores the digitized still image in response to a store image command received from one of the footswitch and the hand held terminal;

an application program running on the programmed processor that receives a request directed to the IP address for the digitized still image from the network via the network interface adapter, and generates a reply transmitting the digitized image to an IP address associated with the request.

11. The apparatus according to claim **10**, wherein the application program transmits the digitized still image to an electronic storage device.

12. The apparatus according to claim **11**, wherein the digital image is transmitted over one of a local area network and a wide area network.

13. The apparatus according to claim **10**, wherein the wide area network comprises the Internet.

14. The apparatus according to claim **10**, wherein the digital representation comprises one of a .tiff format digital representation and a DICOM (digital imaging and communications in medicine) format digital representation.

15. The apparatus according to claim **10**, wherein the analog video input signal is formatted in one of PAL and NTSC format video.

16. The apparatus according to claim **10**, wherein the application program detects whether the hand held terminal is available, and assigns a default file name if the hand held terminal is not connected to the interface for attaching the hand held terminal.

17. The apparatus according to claim **16**, wherein the application program assigns a default file name if no input device is connected to the interface.

18. The apparatus according to claim **10**, further comprising a CD writer, and wherein the application writes the digitized image to a CD using the CD writer as a session.

19. The apparatus according to claim **18**, wherein the application closes the CD after writing the session to the CD.

20. A storage medium storing instructions which, when executed on a programmed processor in a medical image archiving device, carry out a process of:

sending a prompt for image identification information to a hand held terminal;

receiving the image identification information from the hand held terminal;

receiving a grab image command from one of a footswitch and the hand held terminal;

receiving an analog video input signal from a medical imaging device;

converting a frame of the analog video input signal to a digital representation within the image archiving device in response to receiving the grab image command from one of the footswitch and hand held terminal;

receiving a store image command from one of the footswitch and the hand held terminal;

assigning a file name to the digital representation based on the image identification information;

storing the digital representation on a disc drive;

receiving a burn CD command from one of the footswitch and the hand held terminal; and

storing the digital representation as a part of a session on an optical storage medium.

21. The method according to claim **19**, further comprising transmitting the digital representation over one of a wide area network and a local area network.

* * * * *

US006678703B2

(12) **United States Patent**
Rothschild et al.

(10) **Patent No.: US 6,678,703 B2**
(45) **Date of Patent: Jan. 13, 2004**

(54) **MEDICAL IMAGE MANAGEMENT SYSTEM AND METHOD**

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(73) Assignee: **Radvault, Inc.**, Hayward, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 322 days.

(21) Appl. No.: **09/771,446**

(22) Filed: **Jan. 25, 2001**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**[7] **G06F 17/30**

(52) **U.S. Cl.** **707/201**; 707/2; 707/3; 707/10; 707/104; 382/132; 705/3

(58) **Field of Search** 707/3, 2, 10, 101, 707/102, 104, 201; 709/229; 705/2, 37, 3; 382/128, 132

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,847,694	A	7/1989	Nishihara
4,958,283	A	9/1990	Tawara et al.
4,993,025	A	2/1991	Vesel et al.
5,124,789	A	6/1992	Hiyama et al.
5,140,518	A	8/1992	Ena
5,231,572	A	7/1993	Shigyo et al.
5,235,510	A	8/1993	Yamada et al.
5,321,520	A	6/1994	Inga et al.
5,374,965	A	12/1994	Kanno
5,384,643	A	1/1995	Inga et al.
5,416,602	A	5/1995	Inga et al.
5,469,353	A	11/1995	Pinsky et al.
5,502,576	A	3/1996	Ramsay et al.
5,502,726	A	3/1996	Fischer
5,513,101	A	4/1996	Pinsky et al.
5,586,262	A	12/1996	Komatsu et al.
5,654,555	A	8/1997	Butaert et al.
5,655,084	A	8/1997	Pinksy et al.

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

WO	WO 99 18502	A	4/1999
WO	WO 00 33157	A	6/2000
WO	WO 00 33231	A	6/2000

OTHER PUBLICATIONS

Patent Abstracts of Japan vol. 2000, No. 01, Jan. 31, 2000 & JP 11 284974 A (Fuji Photo Film Co. Ltd.), Oct. 15, 1999 abstract.

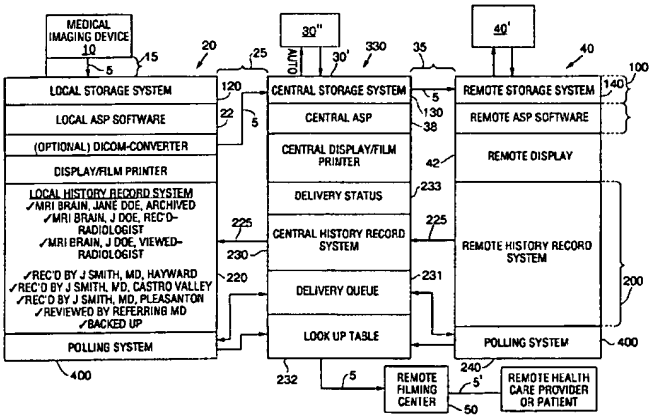
Patent Abstracts of Japan vol. 2000, No. 01, Jan. 31, 2000 & JP 11 284682 A (Fuji Photo Film Co. Ltd.), Oct. 15, 1999 abstract.

Primary Examiner—Jean M. Corrielus
(74) *Attorney, Agent, or Firm*—Susan M. Schmitt

(57) **ABSTRACT**

The present invention provides a medical image management system and method that uses a central data management system to centrally manage the storage and transmission of electronic records containing medical images between remotely located facilities. A polling system is provided with remotely located workstations or local workstations so that the remote or local workstations may request queued data to be delivered that is awaiting delivery in the central database management system. The remotely located workstation or local image workstation communicates with a remotely located central data management system via a remote interface over the internet. The central database management system maintains and update any changes in the IP address of a remote or local workstation, in a look up table. The central data management system may also, in addition, push data when received to the last known IP address in the look up table.

34 Claims, 13 Drawing Sheets



U.S. PATENT DOCUMENTS

5,668,998	A		9/1997	Mason et al.
5,671,353	A		9/1997	Tian et al.
5,715,823	A		2/1998	Wood et al.
5,734,915	A		3/1998	Roewer
5,740,428	A		4/1998	Mortimore et al.
5,793,969	A		8/1998	Kamentsky
5,851,186	A		12/1998	Wood et al.
5,857,030	A		1/1999	Goborski et al.
5,897,498	A		4/1999	Canfield, II et al.
5,949,491	A		9/1999	Callahan et al.
5,950,207	A		9/1999	Mortmore et al.
5,959,678	A		9/1999	Callahan et al.
6,006,191	A	*	12/1999	DiRienzo 705/2
6,047,081	A		4/2000	Groezinger et al.
6,101,407	A		8/2000	Groezinger
6,115,486	A		9/2000	Cantoni
6,117,079	A		9/2000	Brackett et al.
6,128,655	A	*	10/2000	Fields et al. 709/219
6,137,527	A		10/2000	Abdel-Malek et al.
6,159,150	A		12/2000	Yale et al.
6,171,244	B1		1/2001	Finger et al.
6,178,225	B1		1/2001	Zur et al.
6,192,407	B1	*	2/2001	Smith et al. 709/229
6,210,327	B1		4/2001	Brackett et al.
6,487,599	B1	*	11/2002	Smith et al. 709/229
2001/0032263	A1	*	10/2001	Gopal et al. 709/227

* cited by examiner

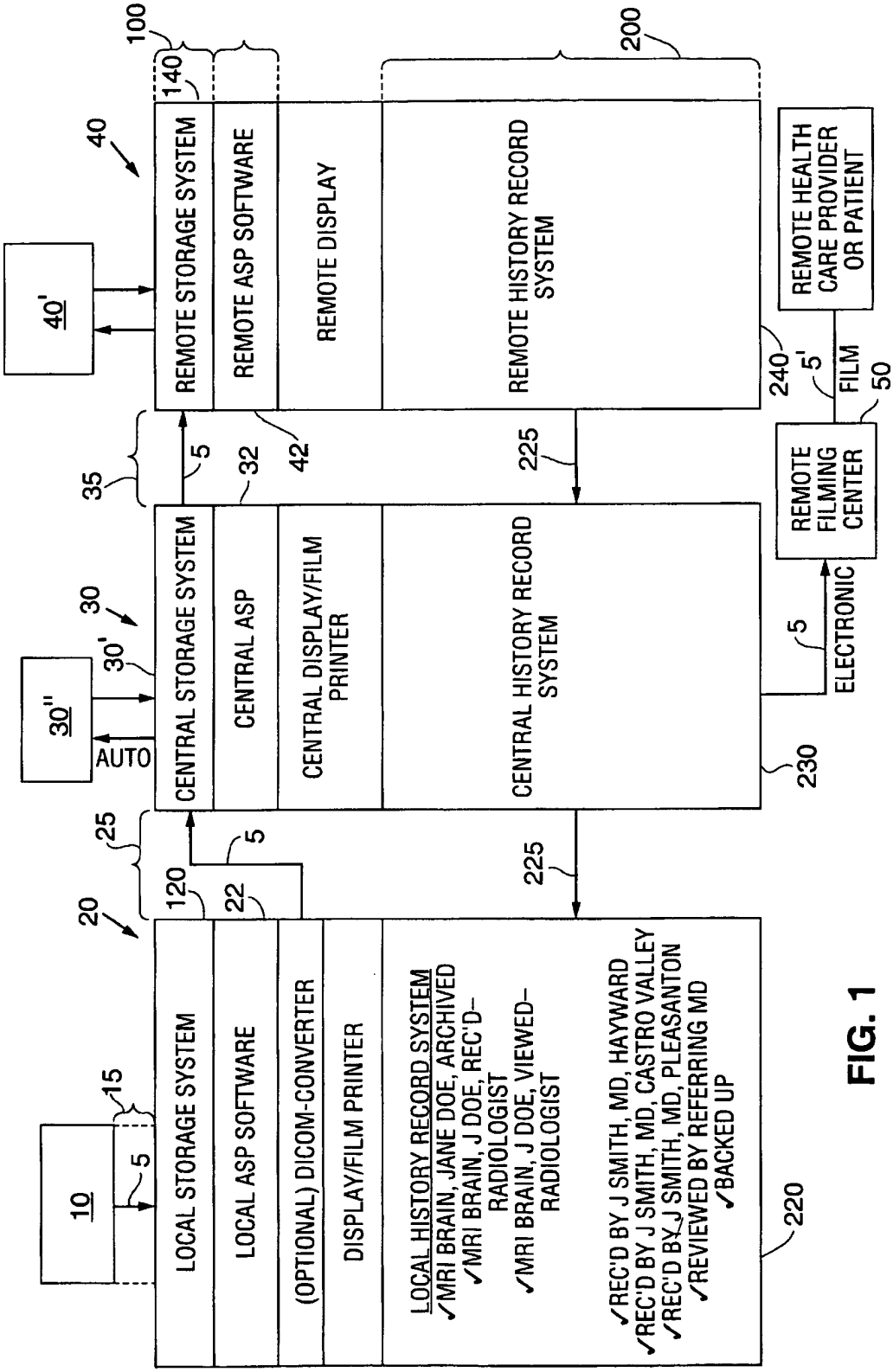

10
5
15
LOCAL STORAGE SYSTEM
LOCAL ASP SOFTWARE
(OPTIONAL) DICOM-CONVERTER
DISPLAY/FILM PRINTER
LOCAL HISTORY RECORD SYSTEM
✓MRI BRAIN, JANE DOE, ARCHIVED
✓MRI BRAIN, J DOE, REC'D-RADIOLOGIST
✓MRI BRAIN, J DOE, VIEWED-RADIOLOGIST
✓REC'D BY J SMITH, MD, HAYWARD
✓REC'D BY J SMITH, MD, CASTRO VALLEY
✓REC'D BY J SMITH, MD, PLEASANTON
✓REVIEWED BY REFERRING MD
✓BACKED UP
220
20
25
120
22
5
225
CENTRAL STORAGE SYSTEM
CENTRAL ASP
CENTRAL DISPLAY/FILM PRINTER
CENTRAL HISTORY RECORD SYSTEM
230
30
30'
30''
AUTO
35
5
32
42
REMOTE STORAGE SYSTEM
REMOTE ASP SOFTWARE
REMOTE DISPLAY
REMOTE HISTORY RECORD SYSTEM
100
140
200
40
40'
240
5'
FILM
50
REMOTE FILMING CENTER
ELECTRONIC
REMOTE HEALTH CARE PROVIDER OR PATIENT

FIG. 1

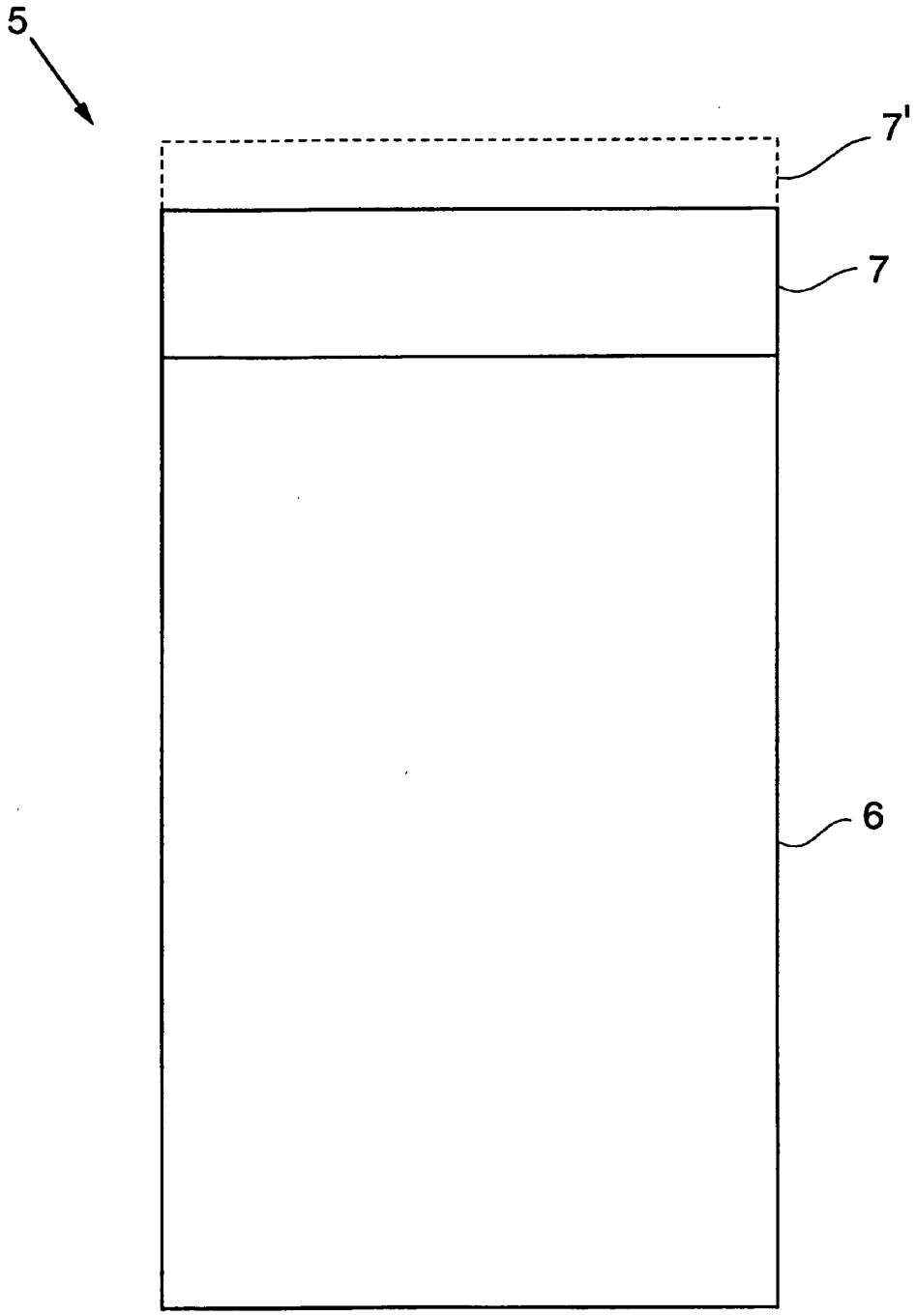


FIG. 2

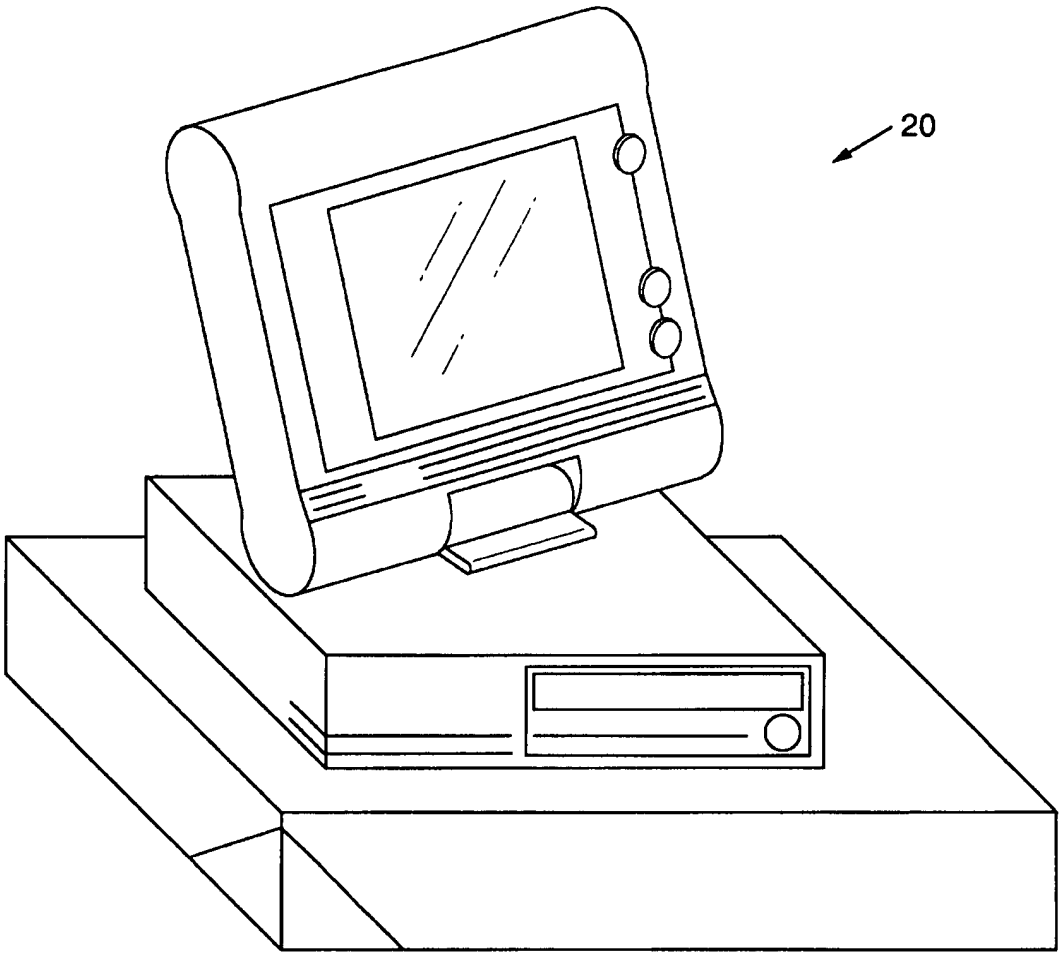


FIG. 3

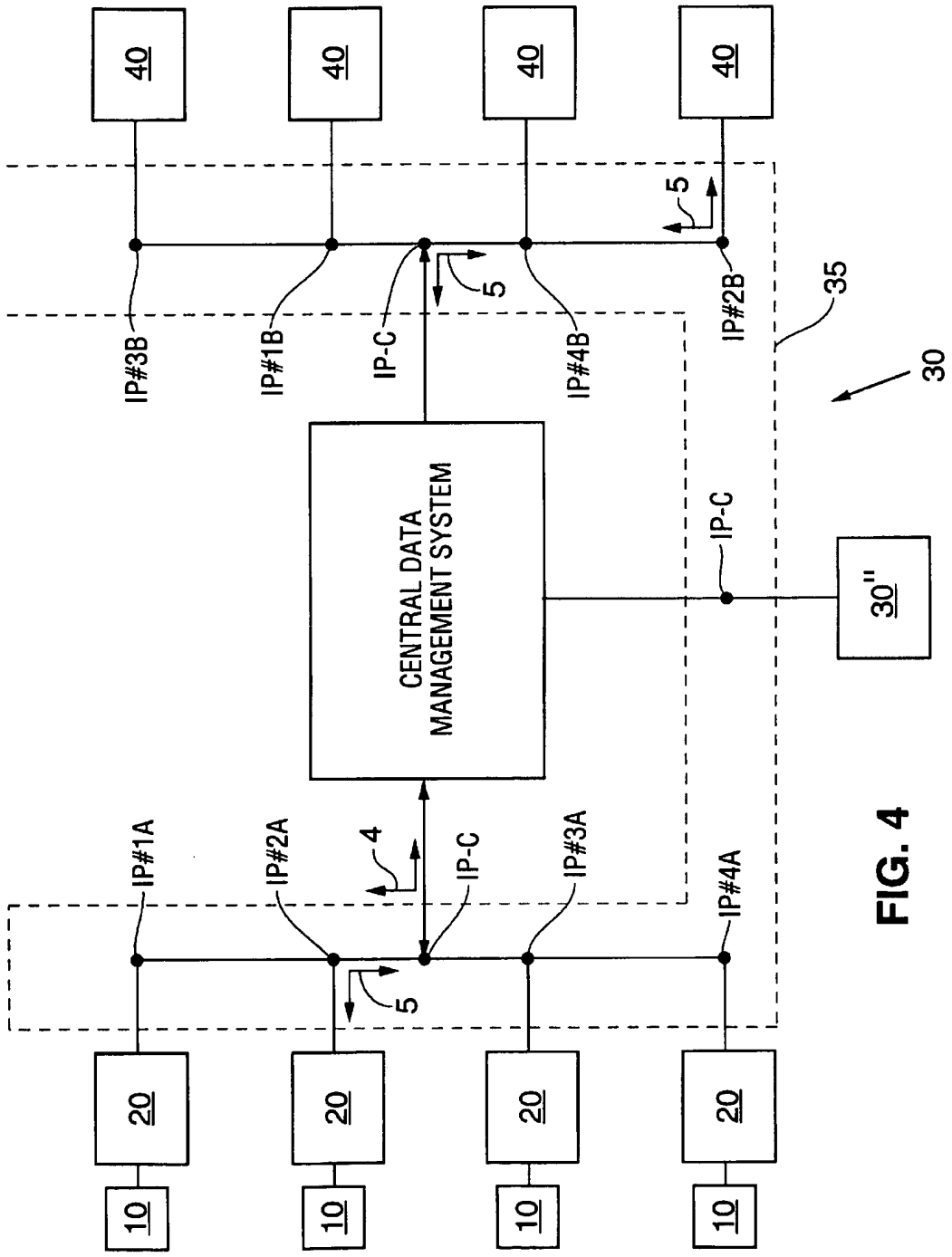

40
40
40
40
5
5
IP#3B
IP#1B
IP-C
IP#4B
IP#2B
35
30
CENTRAL DATA MANAGEMENT SYSTEM
IP-C
30"
IP#1A
IP#2A
4
IP-C
IP#3A
IP#4A
5
20
20
20
20
10
10
10
10

FIG. 4

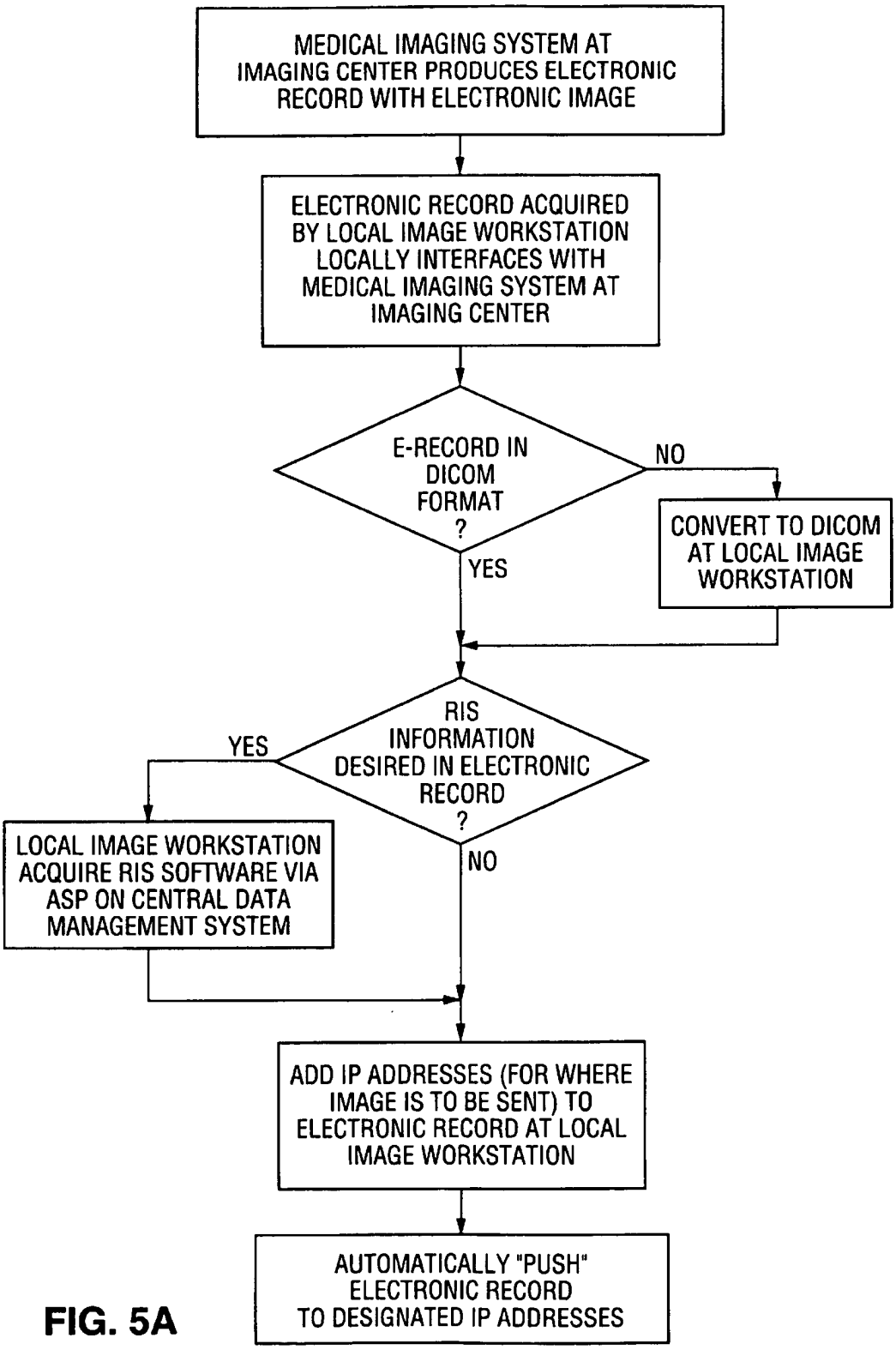

MEDICAL IMAGING SYSTEM AT IMAGING CENTER PRODUCES ELECTRONIC RECORD WITH ELECTRONIC IMAGE
ELECTRONIC RECORD ACQUIRED BY LOCAL IMAGE WORKSTATION LOCALLY INTERFACES WITH MEDICAL IMAGING SYSTEM AT IMAGING CENTER
E-RECORD IN DICOM FORMAT ?
NO
CONVERT TO DICOM AT LOCAL IMAGE WORKSTATION
YES
RIS INFORMATION DESIRED IN ELECTRONIC RECORD ?
YES
LOCAL IMAGE WORKSTATION ACQUIRE RIS SOFTWARE VIA ASP ON CENTRAL DATA MANAGEMENT SYSTEM
NO
ADD IP ADDRESSES (FOR WHERE IMAGE IS TO BE SENT) TO ELECTRONIC RECORD AT LOCAL IMAGE WORKSTATION
AUTOMATICALLY "PUSH" ELECTRONIC RECORD TO DESIGNATED IP ADDRESSES

FIG. 5A

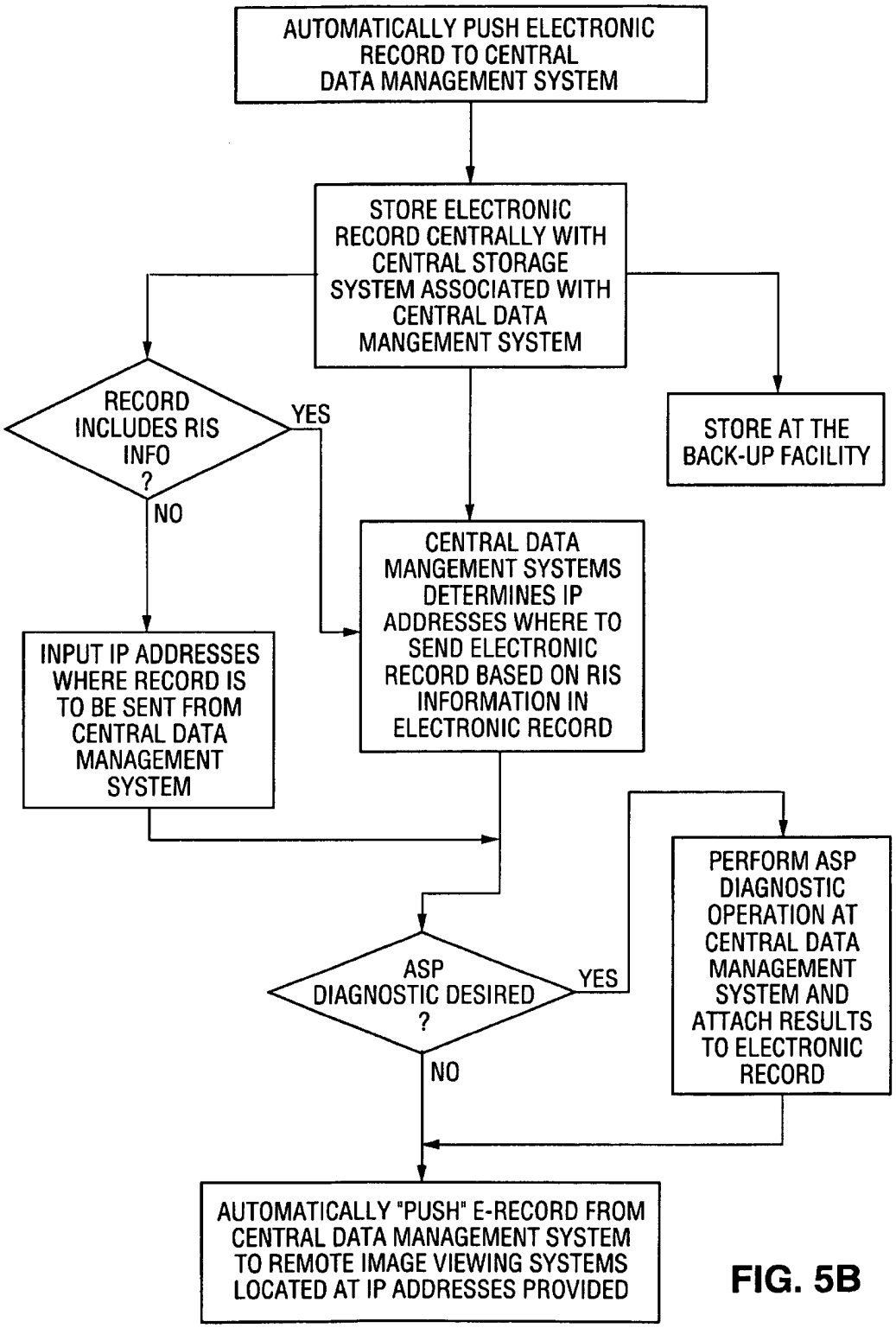

AUTOMATICALLY PUSH ELECTRONIC RECORD TO CENTRAL DATA MANAGEMENT SYSTEM
STORE ELECTRONIC RECORD CENTRALLY WITH CENTRAL STORAGE SYSTEM ASSOCIATED WITH CENTRAL DATA MANGEMENT SYSTEM
STORE AT THE BACK-UP FACILITY
RECORD INCLUDES RIS INFO ?
YES
NO
INPUT IP ADDRESSES WHERE RECORD IS TO BE SENT FROM CENTRAL DATA MANAGEMENT SYSTEM
CENTRAL DATA MANGEMENT SYSTEMS DETERMINES IP ADDRESSES WHERE TO SEND ELECTRONIC RECORD BASED ON RIS INFORMATION IN ELECTRONIC RECORD
ASP DIAGNOSTIC DESIRED ?
YES
NO
PERFORM ASP DIAGNOSTIC OPERATION AT CENTRAL DATA MANAGEMENT SYSTEM AND ATTACH RESULTS TO ELECTRONIC RECORD
AUTOMATICALLY "PUSH" E-RECORD FROM CENTRAL DATA MANAGEMENT SYSTEM TO REMOTE IMAGE VIEWING SYSTEMS LOCATED AT IP ADDRESSES PROVIDED

FIG. 5B

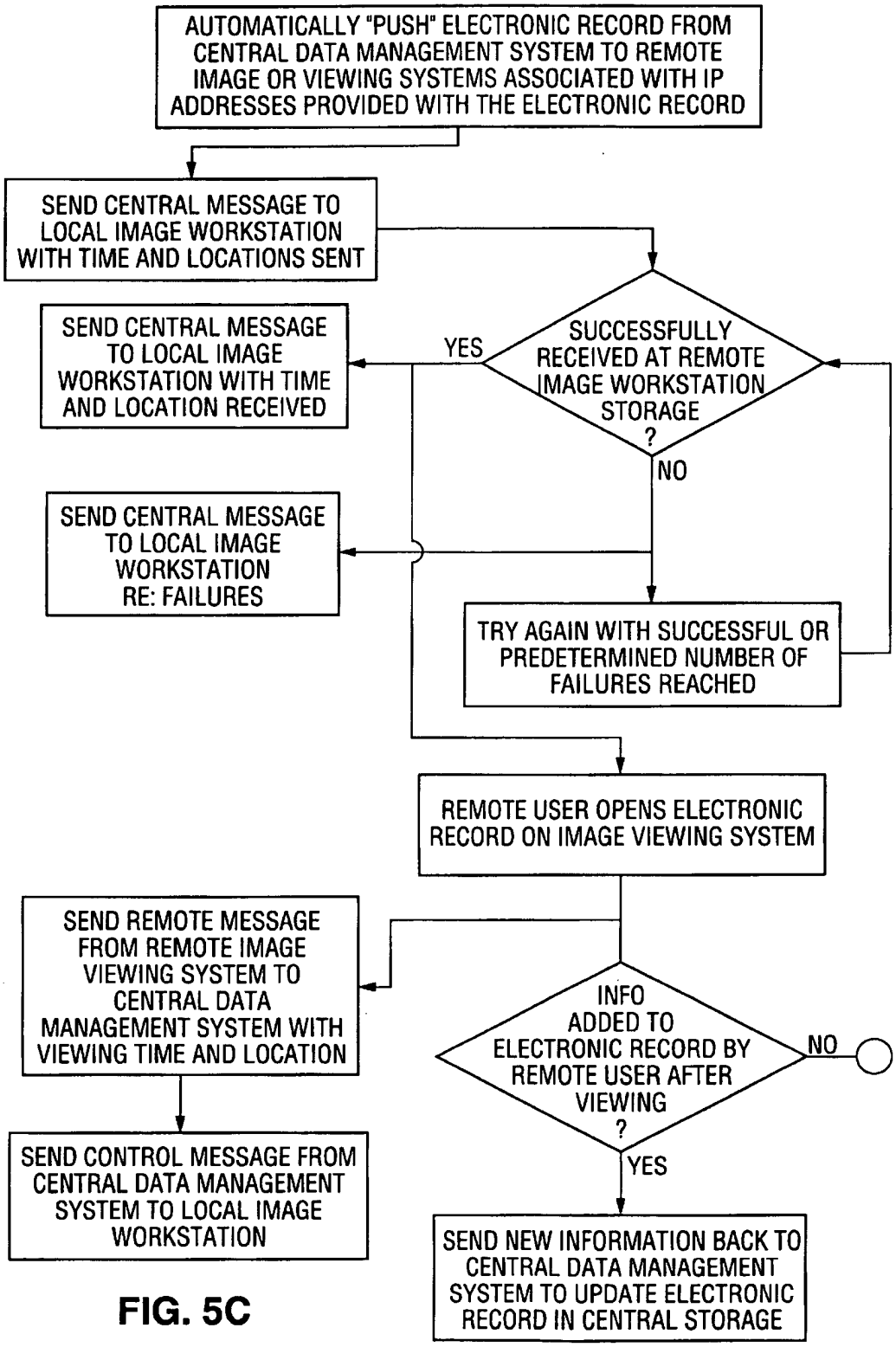

AUTOMATICALLY "PUSH" ELECTRONIC RECORD FROM CENTRAL DATA MANAGEMENT SYSTEM TO REMOTE IMAGE OR VIEWING SYSTEMS ASSOCIATED WITH IP ADDRESSES PROVIDED WITH THE ELECTRONIC RECORD
SEND CENTRAL MESSAGE TO LOCAL IMAGE WORKSTATION WITH TIME AND LOCATIONS SENT
SUCCESSFULLY RECEIVED AT REMOTE IMAGE WORKSTATION STORAGE ?
YES
SEND CENTRAL MESSAGE TO LOCAL IMAGE WORKSTATION WITH TIME AND LOCATION RECEIVED
NO
SEND CENTRAL MESSAGE TO LOCAL IMAGE WORKSTATION RE: FAILURES
TRY AGAIN WITH SUCCESSFUL OR PREDETERMINED NUMBER OF FAILURES REACHED
REMOTE USER OPENS ELECTRONIC RECORD ON IMAGE VIEWING SYSTEM
SEND REMOTE MESSAGE FROM REMOTE IMAGE VIEWING SYSTEM TO CENTRAL DATA MANAGEMENT SYSTEM WITH VIEWING TIME AND LOCATION
INFO ADDED TO ELECTRONIC RECORD BY REMOTE USER AFTER VIEWING ?
NO
YES
SEND CONTROL MESSAGE FROM CENTRAL DATA MANAGEMENT SYSTEM TO LOCAL IMAGE WORKSTATION
SEND NEW INFORMATION BACK TO CENTRAL DATA MANAGEMENT SYSTEM TO UPDATE ELECTRONIC RECORD IN CENTRAL STORAGE

FIG. 5C

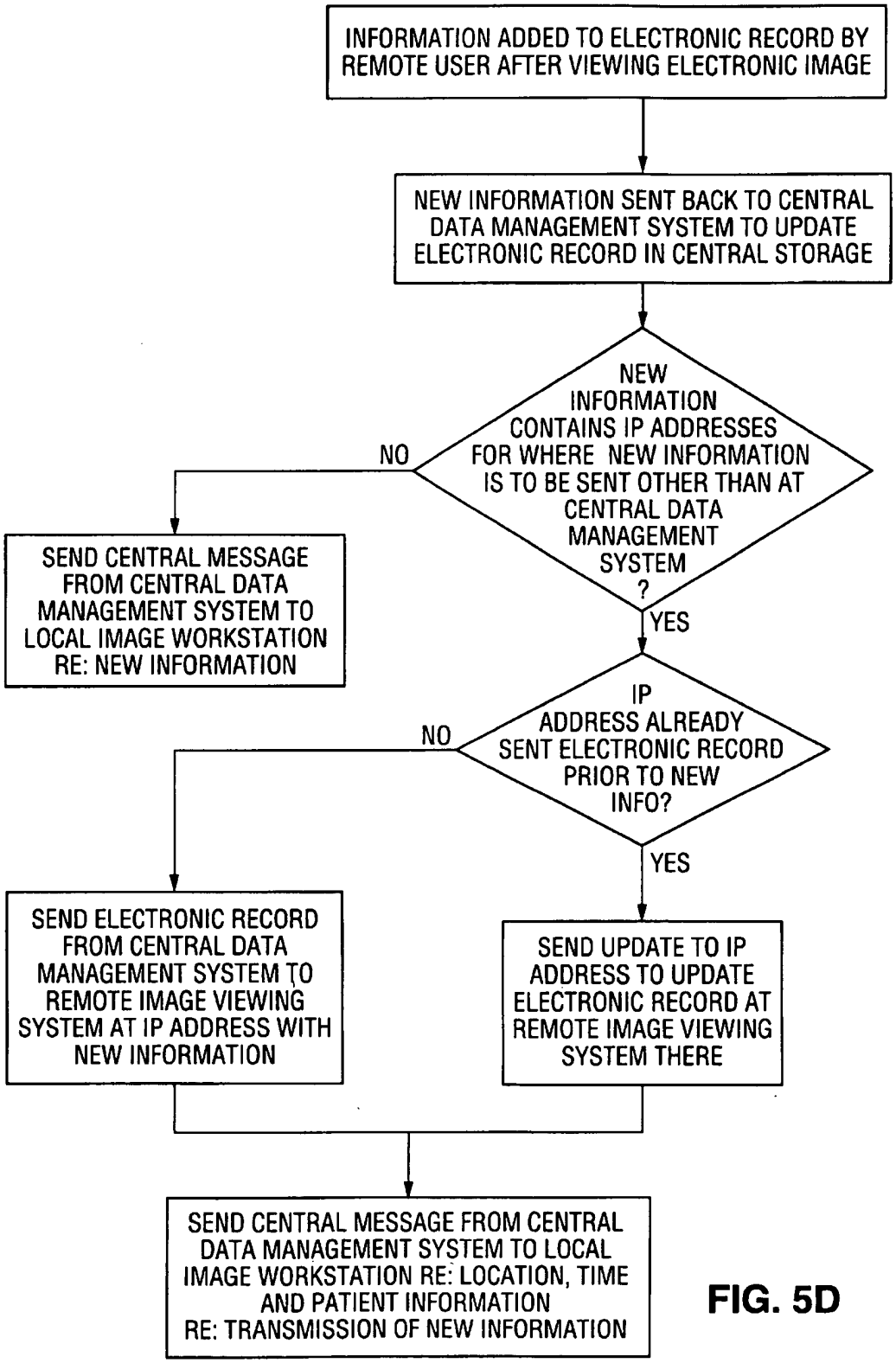

INFORMATION ADDED TO ELECTRONIC RECORD BY REMOTE USER AFTER VIEWING ELECTRONIC IMAGE
NEW INFORMATION SENT BACK TO CENTRAL DATA MANAGEMENT SYSTEM TO UPDATE ELECTRONIC RECORD IN CENTRAL STORAGE
NEW INFORMATION CONTAINS IP ADDRESSES FOR WHERE NEW INFORMATION IS TO BE SENT OTHER THAN AT CENTRAL DATA MANAGEMENT SYSTEM ?
NO
YES
SEND CENTRAL MESSAGE FROM CENTRAL DATA MANAGEMENT SYSTEM TO LOCAL IMAGE WORKSTATION RE: NEW INFORMATION
IP ADDRESS ALREADY SENT ELECTRONIC RECORD PRIOR TO NEW INFO?
NO
YES
SEND ELECTRONIC RECORD FROM CENTRAL DATA MANAGEMENT SYSTEM TO REMOTE IMAGE VIEWING SYSTEM AT IP ADDRESS WITH NEW INFORMATION
SEND UPDATE TO IP ADDRESS TO UPDATE ELECTRONIC RECORD AT REMOTE IMAGE VIEWING SYSTEM THERE
SEND CENTRAL MESSAGE FROM CENTRAL DATA MANAGEMENT SYSTEM TO LOCAL IMAGE WORKSTATION RE: LOCATION, TIME AND PATIENT INFORMATION RE: TRANSMISSION OF NEW INFORMATION

FIG. 5D

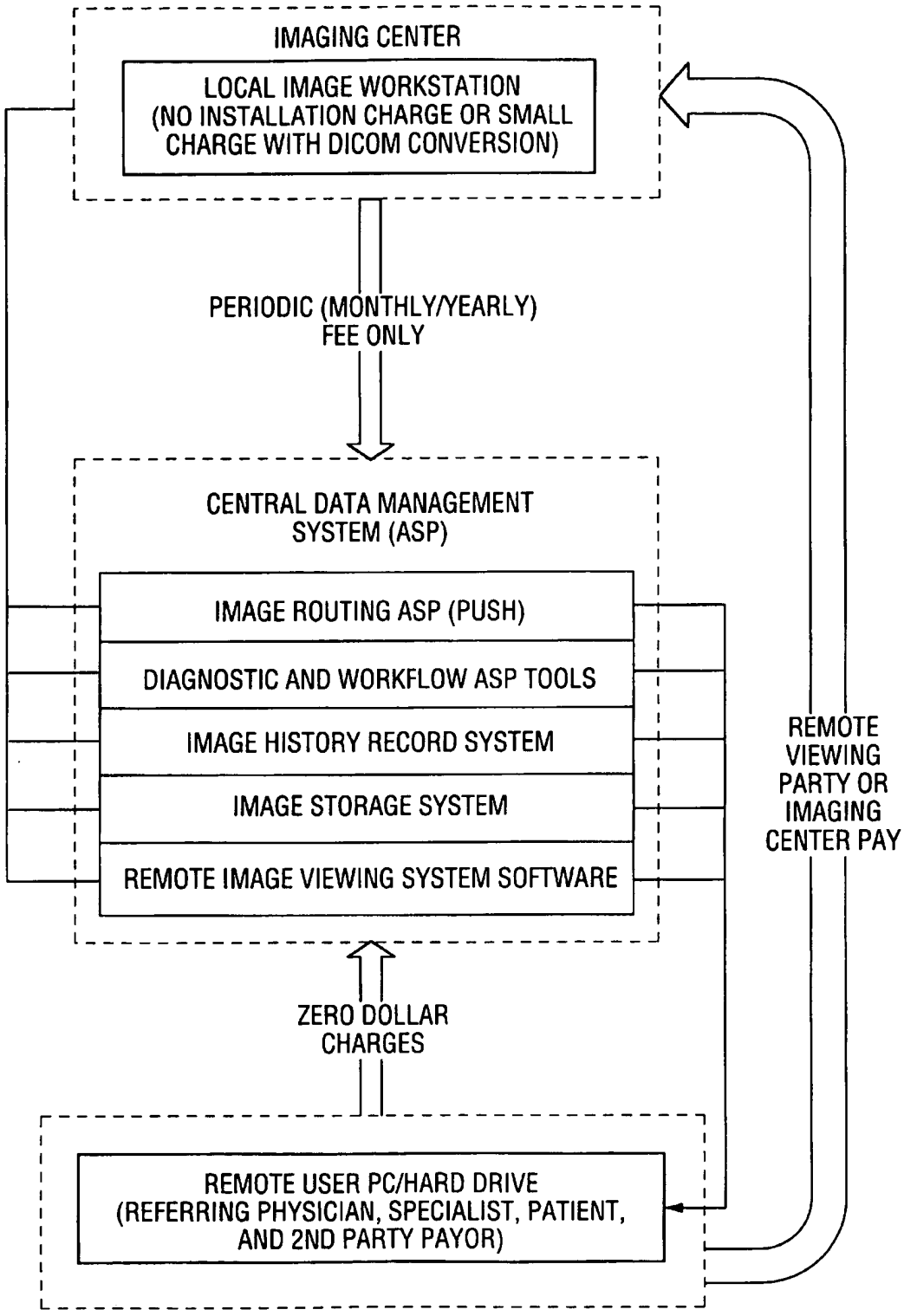

IMAGING CENTER
LOCAL IMAGE WORKSTATION (NO INSTALLATION CHARGE OR SMALL CHARGE WITH DICOM CONVERSION)
PERIODIC (MONTHLY/YEARLY) FEE ONLY
CENTRAL DATA MANAGEMENT SYSTEM (ASP)
IMAGE ROUTING ASP (PUSH)
DIAGNOSTIC AND WORKFLOW ASP TOOLS
IMAGE HISTORY RECORD SYSTEM
IMAGE STORAGE SYSTEM
REMOTE IMAGE VIEWING SYSTEM SOFTWARE
ZERO DOLLAR CHARGES
REMOTE USER PC/HARD DRIVE (REFERRING PHYSICIAN, SPECIALIST, PATIENT, AND 2ND PARTY PAYOR)
REMOTE VIEWING PARTY OR IMAGING CENTER PAY

FIG. 6

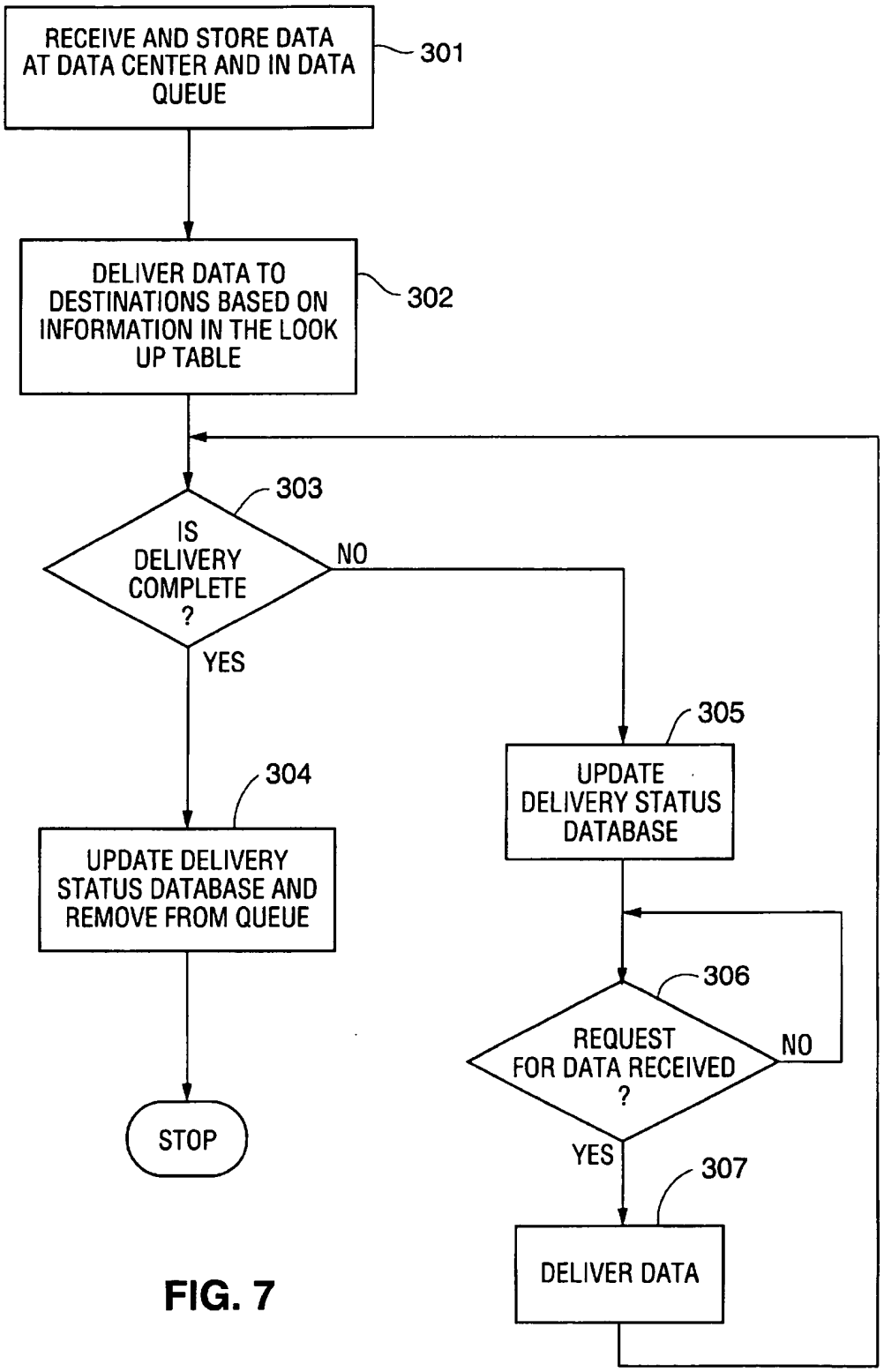

RECEIVE AND STORE DATA AT DATA CENTER AND IN DATA QUEUE
301
DELIVER DATA TO DESTINATIONS BASED ON INFORMATION IN THE LOOK UP TABLE
302
303
IS DELIVERY COMPLETE ?
NO
YES
304
UPDATE DELIVERY STATUS DATABASE AND REMOVE FROM QUEUE
STOP
305
UPDATE DELIVERY STATUS DATABASE
306
REQUEST FOR DATA RECEIVED ?
NO
YES
307
DELIVER DATA

FIG. 7

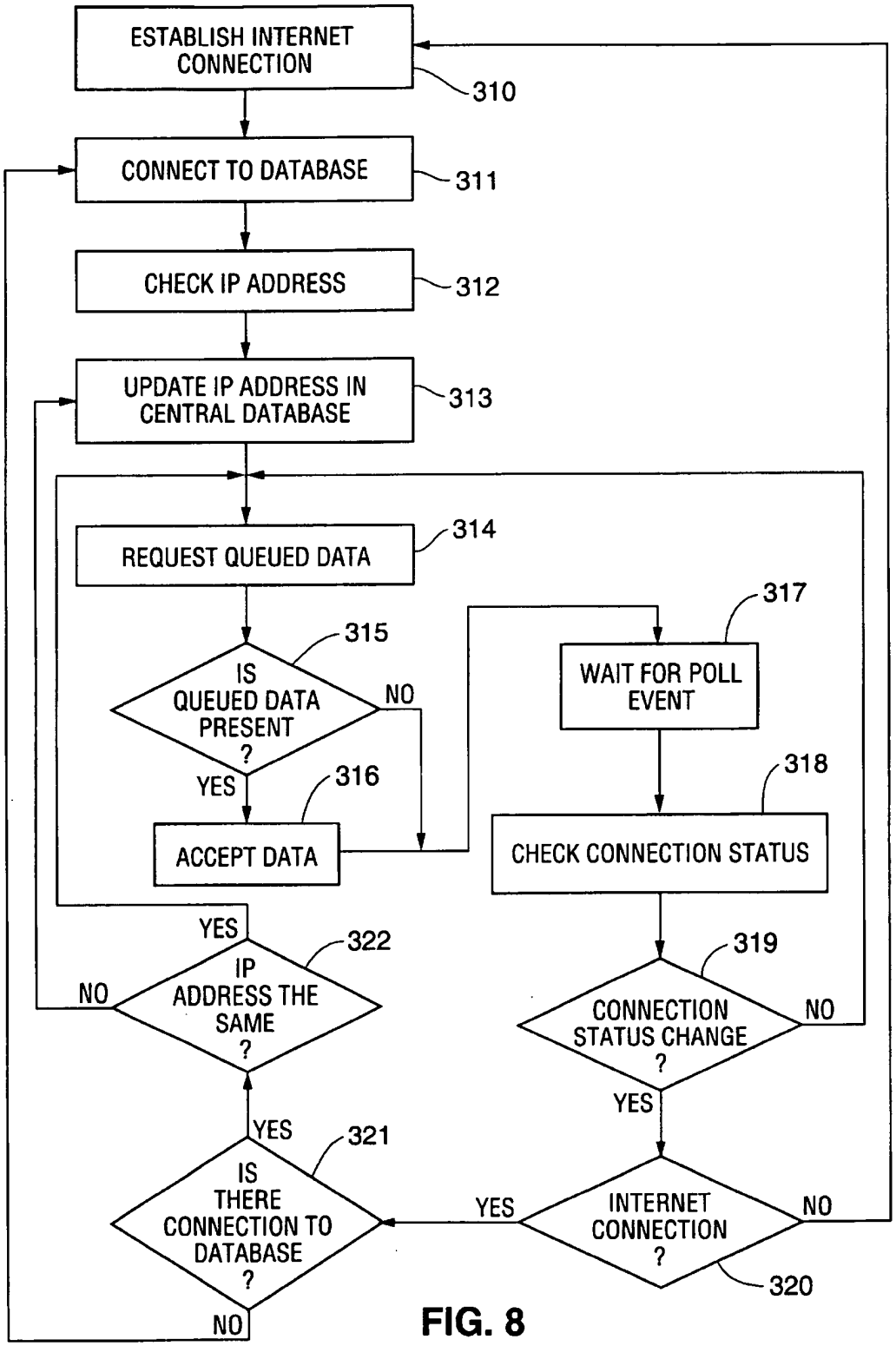

ESTABLISH INTERNET CONNECTION
310
CONNECT TO DATABASE
311
CHECK IP ADDRESS
312
UPDATE IP ADDRESS IN CENTRAL DATABASE
313
REQUEST QUEUED DATA
314
IS QUEUED DATA PRESENT ?
315
NO
YES
ACCEPT DATA
316
WAIT FOR POLL EVENT
317
CHECK CONNECTION STATUS
318
CONNECTION STATUS CHANGE ?
319
NO
YES
INTERNET CONNECTION ?
320
NO
YES
IS THERE CONNECTION TO DATABASE ?
321
NO
YES
IP ADDRESS THE SAME ?
322
NO
YES

FIG. 8

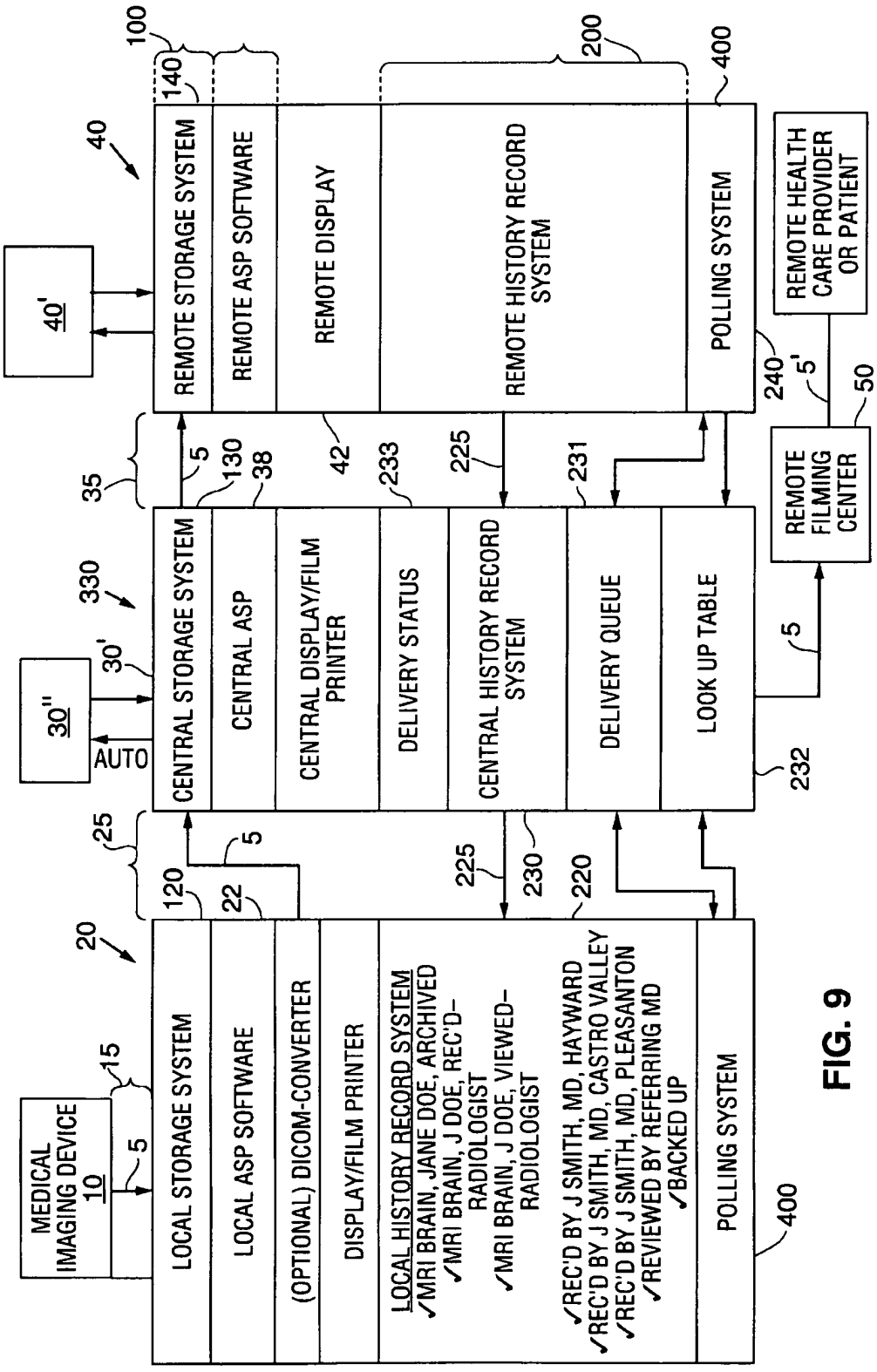

MEDICAL IMAGING DEVICE 10
LOCAL STORAGE SYSTEM
LOCAL ASP SOFTWARE
(OPTIONAL) DICOM-CONVERTER
DISPLAY/FILM PRINTER
LOCAL HISTORY RECORD SYSTEM
✓MRI BRAIN, JANE DOE, ARCHIVED
✓MRI BRAIN, J DOE, REC'D-RADIOLOGIST
✓MRI BRAIN, J DOE, VIEWED-RADIOLOGIST
✓REC'D BY J SMITH, MD, HAYWARD
✓REC'D BY J SMITH, MD, CASTRO VALLEY
✓REC'D BY J SMITH, MD, PLEASANTON
✓REVIEWED BY REFERRING MD
✓BACKED UP
POLLING SYSTEM
CENTRAL STORAGE SYSTEM
CENTRAL ASP
CENTRAL DISPLAY/FILM PRINTER
DELIVERY STATUS
CENTRAL HISTORY RECORD SYSTEM
DELIVERY QUEUE
LOOK UP TABLE
AUTO
REMOTE STORAGE SYSTEM
REMOTE ASP SOFTWARE
REMOTE DISPLAY
REMOTE HISTORY RECORD SYSTEM
POLLING SYSTEM
REMOTE FILMING CENTER
REMOTE HEALTH CARE PROVIDER OR PATIENT
40'
30''
40
20
30'
330
35
25
15
5
120
22
130
38
42
233
225
231
232
230
220
140
100
200
400
240
5'
50

FIG. 9

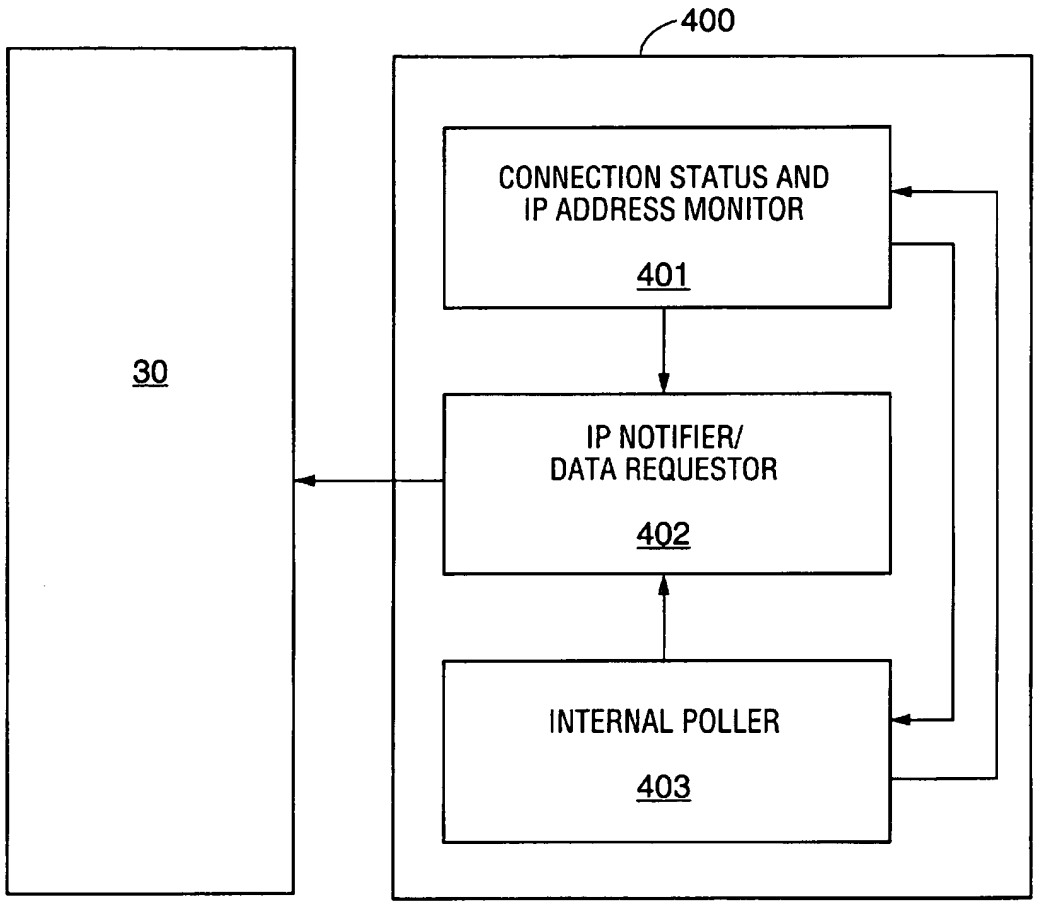

400
30
CONNECTION STATUS AND IP ADDRESS MONITOR
401
IP NOTIFIER/ DATA REQUESTOR
402
INTERNAL POLLER
403

FIG. 10

MEDICAL IMAGE MANAGEMENT SYSTEM AND METHOD

This application is a continuation-in-part of 09/602,643 filed Jun. 22, 2000.

TECHNICAL FIELD

The present invention is a system and method for managing medical images. More specifically, it is a computer-based system and method for capturing, transmitting, storing, processing, and communicating electronic records associated with medical images.

BACKGROUND

Diagnostic imaging technology has evolved tremendously in the past twenty years, offering very sophisticated imaging tests such as magnetic resonance imaging (MRI) and computed tomography (CT). The MRI market in particular includes approximately 6,000 MRI machines in the United States, and 12,000 worldwide. Two-thirds of MRI devices in the US are located clinics and small hospitals. There are over 12,000 CT scanners in the United States and over 20,000 worldwide. Other significant medical imaging markets include for example, ultrasound, nuclear medicine, digital x-ray, and computerized radiology. On the aggregate, the potential medical image management market has been estimated at $5.5 Billion annually in the US and $12 Billion worldwide.

The need for immediate electronic delivery and convenient, economic storage of radiologic and other medical images and data has never been greater. The annual United States radiology market consists of more than 150 million x-rays, 100 million sonograms, 20 million MRI scans and 30 million CT scans performed by medical practitioners. The conventional process for managing medical images at most hospitals, clinics and imaging centers is as follows. The medical image is printed onto sheets of film, which are delivered to the radiologist for interpretation. After the transcribed report is delivered to the radiologist, reviewed for errors and signed, the films and report are delivered or mailed to the referring doctor. This process often takes several days, up to a week. If questions arise, the referring doctor contacts the radiologist, who may be forced to rely upon memory, having reviewed the films several days before and no longer has possession of them. Also, the referring doctor must then manage the hard-copy films, either by filing the films in his office, or returning the films to the imaging center or hospital to be filed, depending upon practices in the local community. If the patient then goes to a second doctor, requires surgery, or requires another medical imaging procedure, the films must be located and physically carried or shipped to the hospital, surgery center, or to the second doctor's office. There are numerous opportunities for films to be lost or misfiled, and doctors who maintain more than, one office may not always have the correct patient films in the correct office.

The current film-based system is very expensive, and the charges for films, processing chemicals, and delivery can easily add up to $30 to $50 per MRI patient study. A typical MRI center scanning 300 patients per month has equivalent costs of approximately $12,000 per month ($40 per study× 300 patients/month). Other problems for the imaging facility are the numerous opportunities for the films to be physically lost, as well as the considerable time, personnel, and expense required for the delivery and retrieval of these films. Estimates are that up to 25% of medical images are not accessible when required.

Currently, no widely established commercial Internet solution exists for the digital delivery and archiving of the ever-increasing vast stores of radiologic data. Many patients are accustomed to sending email with various attachments, such as files or photos, and wonder why radiology images cannot be "emailed" to their doctors. However, several barriers exist for a medical image to be "emailed" to the doctor.

In order to electronically transport medical images efficiently, the images must be in a digital format. The imaging device, such as the MRI machine, must have the computer interfacing hardware and software configured to "export" the data. A computer is needed to convert the proprietary image identification data (the header information) into a standardized format, such as DICOM (Digital Imagine, and Communication in Medicine). Also, the doctor who receives the images must have software that allows him or her to view the medical images and interpret the image header information (viewer). However, non-DICOM enabled models represent the majority of imaging machines. Due to financial constraints imposed by managed care on imaging centers, non-DICOM machines will continue to dominate diagnostic imaging for the foreseeable future.

When digital modalities such as CT and MRI first came into general clinical use, each manufacturer used its own proprietary means of reconstructing the data, formatting files and storing each of the studies. They did not share this basic information with other competing manufacturers; therefore, one set of images could not be communicated to another machine since each had a different format. In 1983, the American College of Radiology and the National Electronic Manufacturers Association met to discuss a standard. In early 1984 the two organizations formed the Digital Imaging and Communication in Medicine (DICOM) Standards Committee. After many years of extensive work, the first DICOM model was introduced in 1992. By late 1994, a few manufacturers had begun to offer to incorporate DICOM into their products, usually as an expensive ($20,000–$40,000) upgrade. However, even today, the majority of these manufacturers still today only incorporate DICOM in their new products for a significant extra charge ($20,000-$40,000). Many of the older established medical imaging systems do not even have a DICOM conversion available from the original equipment manufacturer. Whenever a DICOM conversion upgrade is available for already built and installed products, it is usually even more expensive than DICOM for a new product. DICOM is a communications standard and does not define particular hardware architecture. It permits integration of images into non-image databases and is the predominant standard for medical image communication. It enjoys broad support across specialties and other standards organizations throughout the world.

Interfaces have been developed to "DICOM enable" imaging systems that were not originally factory equipped with DICOM. Without supplying DICOM interfaces as a component of an overall system, a medical image management system in the general field contemplated by the invention would be required to take one of three courses of action: 1) limit their imaging center users to DICOM conformant equipment, 2) purchase or require their customer to purchase and install DICOM interfaces at a cost of upwards of $40,000, or 3) rely on a technique known as secondary capture. In the case of secondary capture methods, like video frame grabbing, some of the information is lost, because it only captures the 8-bit analog representation of the original 16-bit image pixel data. Also, secondary captured images

cannot be later manipulated to the same degree as the original images. Because of the inherent drawbacks of secondary captured data, the American College of Radiology (ACR) standard states that the direct capture method is preferred for primary diagnosis.

It is not believed that the general imaging center and referring physician marketplace will tolerate the use of the inferior secondary capture method, or an ASP that can only connect to DICOM equipped imaging systems. The system and method of the present invention provides DICOM connectivity. Also, in order to transmit and store images without compromising the quality or integrity of the imaging data, an efficient medical image management system is preferably able to successfully connect disparate imaging equipment and systems without compromising the image quality. To accomplish this the system should be able to extract the proprietary data from various different imaging machines, again the vast majority of which are not DICOM enabled and therefore cannot "output" the data in the DICOM format. Moreover, though DICOM is the universal industry standard, like the English language different "dialects" of DICOM exist depending on how each of the many individual manufacturers "speak" the DICOM language. What this means is that it is quite common for two systems that have DICOM interfaces to still have difficulty connecting and communicating with each other. Therefore, customization of interfacing, between such machines may be required in some circumstances.

Once these above barriers are overcome, it becomes possible to electronically transmit medical images in an efficient and readily adoptable manner. These electronic images, unlike film, can be simultaneously presented in multiple locations immediately after an imaging study is performed.

Picture Archiving and Communication Systems (PACS)

Various solutions have been developed with the intention of streamlining the storage and accessibility of medical images by managing, electronic records that include the images in electronic form that may be converted for viewing, such as on screen displays or via film printers.

One well-known type of such a system called "Picture Archiving and Communications Systems" (PACS) generally provides medical image management via a collection of components that enable image data acquisition, transmission, display, and, storage. Such systems are implemented in imaging clinics and hospitals to make the digital data available at different locations within the radiology department or the facility. Further, the use of such systems is generally restricted to in-house radiology and other departments, thus excluding the referring physicians, who are outside the imaging facility. These systems have high price tags ($60,000 to $ 1,000,000) for the local installation of the respective central image management and storage systems generally required, and involve other high costs related to additional personnel to configure and maintain such image management systems locally onsite at the imaging facility.

Medical Images and Internet ASP's

Because the medical image management market is so large, and represents such large volumes of recurring transmissions of electronic records associated with medical images, an ASP model for managing electronic images provides great potential for a highly profitable annuity business. Various efforts have recently been made to replace or at least significantly enhance the conventional film-based systems and methods for medical image management by managing these images electronically, and more particularly via an internet-based ASP model. However, the concept of an Internet based Application Service Provider (ASP) for the transmission and storage of medical images is an industry in its an embryonic stage. Very few, if any, of the over 300 diagnostic imaging procedures performed annually in the U.S. are being transmitted and/or stored utilizing an ASP model.

To transmit an image electronically as is intended with these known medical image management systems, the first step is to get the data from the imaging modality (CT, MR, ultrasound, etc.) to the image acquisition system at the customer site. There are two methods of obtaining this data: primary and secondary data capture. Because primary capture is not always possible in order to support other known medical image management systems and methods, they often use "secondary" or "indirect" methods. The simplest and oldest "secondary" capture method is often called "frame grabbing". This method simply obtains the image present on the video monitor and records it. The resulting image is only 8 bits deep allowing 256 shades of gray, which means a significant amount of image data has been lost. The use of "frame grabbing" is also very labor intensive. When using "frame grabbing", the technologists must pre-set the "window" and "level" (brightness and contrast) of the image. This requires an excessive amount of the technologist's time when compared to the more modem primary capture. These frame grabber systems work by taking the analog monitor output from a digital modality and running it through an analog-to-digital converter, which in itself degrades the data. The ability to adjust the brightness and contrast (window and level) of the image on the receiving end is also limited with images that were obtained using "secondary" capture. Measurements and position location of the image, both extremely important to the physician, are not generally possible with acceptable accuracy using secondary capture. Furthermore, due to problems described above, the latest version of the American College of Radiology (ACR) standards for teleradiology effective Jan. 1, 1999, recommends compliance to DICOM and transfer of the full image data set, which is only possible with "primary" or "direct capture" for primary diagnosis.

In general, most of the known systems and methods for managing medical images in electronic record format use "pull" type image delivery protocol which requires the referring physician to log on to a web server and then download his or her patient's images. However, busy physicians do not have the time or the desire to access their patient's images in this manner. The "pull" model requires the physician to log in as well as extensive physician input and time to initiate the data transfer. Additionally, the doctor must then wait for the image data to download.

Various more specific examples of such medical image ASP efforts are summarized in relation to respectively known companies in the general field as follows (much of the information provided immediately below is based upon information and belief, and in some cases is based only on rumor and verbal discussion—therefore the general and detailed elements for these companies may not be wholly accurate).

The following is a description of what is believed to be information related to a medical image management system to be provided by a company called "Amicas". Amicas is a private company located in Newton, Mass. that is believed to market and sell software that allows radiology studies to be sent between Web servers. The target market for Amicas is believed to be large hospitals. It is believed that Amicas plans to enable the transfer of such images between any

medical facilities that have standard e-mail systems, using UPS Document Exchange (SM)—an encryption-based secure delivery service featuring optional password protection, real-time racking and delivery confirmation. The physician still must login to get his or her email, and wait for the images to download. The company is currently using the service at 4 beta sites. The Company gained FDA approval in 1997. To qualify as a potential customer a client's machines must have DICOM installed. CEO Dr. Adrian Gropper stated in an interview conducted May 2, 2000 at the E-Healthcare Conference in Las Vegas Nev. that Amicas has no plans to develop custom DICOM interfaces. Dr. Gropper has also stated that his company has no plans to offer any form of off site storage. It is further believed that the company uses lossy compression of the electronic records associated with medical images they manage. It is believed that Amicas has a test site which is located at the Loma Linda Veterans Administration Hospital.

The following is a description of what is believed to be information related to a medical image management system to be provided by a company called "eMed". eMed is a private company located in Lexington, Mass. The target users are hospitals. The eMed.net service is believed to include a medical image viewing application with integrated access to medical images and reports along with other relevant information through a physician's web site. eMed Technologies is a Healthcare Application Service Provider (HASP) and takes care of everything from server hardware, domain name registration, site creation and current content, all for a monthly subscription fee of $2,500. The company has FDA approval. The company prefers DICOM equipped machines, but is able to capture images from non-DICOM imaging machines in two ways: (1) DICOM converting device at a customer cost of up to $40,000; and (2) frame grabbing—a form of secondary capture which is believed to be unacceptable for primary diagnostic interpretation.

The following is a description of what is believed to be information related to a medical image management system to be provided by General Electric Medical Systems, Dallas, Tex. and Waukesha, Wis. stated in a press release dated Apr. 9, 2000 that GE will use an ASP model to primarily store data generated at an off-site location. It is believed that this recent announcement addresses an ASP model for GE's traditional PACS system. The press release claims that GE will pilot the program during the summer of 2000. The press release does not mention numerous details (such as connectivity to their system i.e. whether non-DICOM compliant machines will ever be offered the service; whether only GE or non-GE equipment will be targeted; whether GE plans to develop any DICOM interfaces to non-DICOM equipment; what data specifically is planned to be stored). The press release mentions a network subscription fee arrangement but does not give any pricing details. Most importantly, GE does not deliver the images, but instead has the doctors log on.

The following is a description of what is believed to be information related to a medical image management system to be provided by Image Medical, a private company located in Palo Alto, Calif. The target market is large institutions. Image Medical uses an ASP model to transmit medical images over the Internet. The Image Medical system is called "Practice Builder". It is DICOM compliant and works with existing PACS and provides the ability to access images and reports anywhere. "Practice Builder" includes a "Viewer" for digital medical images, CT, MR, US, DR, CR and NM. The revenue model is an activation fee that covers connectivity, infrastructure and installation costs. A per transaction fee is then charged for image acquisitions, distributions and archival. The company is not developing interfaces for imaging machines that are not DICOM equipped.

The following is a description of what is believed to be information related to a medical image management system to be provided by a company called "Inphact", a private company located in Nashville Tenn. Inphact claims to integrate an Internet based ASP PACS with a RIS. The target market is any hospital or clinic that is unable to afford an in-house PACS. RadWeb™ allows physicians to query radiology images 24/7 via the Internet. The company plans to extend its technology platform in the future to cardiology. The company is not believed to offer push technology, image history record system, or custom DICOM interfaces.

The following is a description of what is believed to be information related to a medical image management system to be provided by In Site One, Inc. which is located in Wallingford, Conn. The primary target market is hospitals. In Site One is a service provider offering digital image storage and archiving for the medical community. For this company, the imaging device must be DICOM compliant. "In Dex" (Internet DICOM Express) is a transaction, pay as you go service for storage and archiving of DICOM images for hospitals. In Dex's open architecture integrates with any PACS component as well as hospital networks and information systems. Images can be accessed via the Internet or through virtual private networks to a hospital's network. In Dex is suited for facilities with or without PACS capabilities. For PACS owners, In Dex enables them to outsource the storage and archiving component. For non-PACS equipped facilities, In Dex delivers storage and archival of a PACS without the high capital outlay, maintenance costs, technical upgrades and staffing support. There is no delivery of images to referring physicians nor do referring physicians have access to view the images they order.

The following is a description of what is believed to be information related to a medical image management system to be provided by Radiology.com, which is located in Los Angeles, Calif. and Chantilly, Va. The target market is hospitals. Radiology.com announced the launch of a service that allows digitized medical images to be stored and retrieved on-line through a central, web-based repository on Mar. 9, 2000. The technology combines DICOM and JAVA that allows a high level of compression and encryption of medical images for transmission to a PC. The system employs an ASP model. The company claims open standards will allow lifetime access to a global central repository of medical images, named "Image Bank". Patients can build their own imaging history through "Patient's Bank" which can be used to obtain discrete second opinions. The revenue model is a pay-as-needed approach. It is believed that this system only exists on paper and no clinical sites have been developed.

The following is a description of what is believed to be information related to a medical image management system to be provided by "Real Time Image", a private company located in San Mateo, Calif. The target market is large hospitals with PACS. PACS on Demand is a product that allows physicians to view images anywhere, anytime, even over dial-up connections. iPACS is a Web server that integrates to PACS, allowing physicians to view images directly from a DICOM archive over the Internet using Microsoft's Internet Explorer™ or Netscape Navigator™ Web-browsers. The user must install plug-in to his or her browser before attempting any use of this product. iPACS "streams" images on the fly using original image data without pre-processing or requiring separate archives.

The following is a description of what is believed to be information related to a medical image management system to be provided by "Stentor", a company located in the Silicon Valley. The target market is hospitals with existing Intranets. The Stentor system is PC based. Stentor's "iSYNTAX" technology delivers images only over existing hospital networks. Stentor has FDA approval. Stentor claims its iSYNTAX system will integrate into any existing hospital network. Stentor can send real time images on as slow as a 1 megabyte per second network connection. Images are encoded using a wavelet technology. A lossless representation of the transmitted image is claimed; however, lossless transmission (as the present invention performs) is not claimed. Stentor claims no bills will be sent until real savings by the imaging department have been demonstrated. Stentor charges on a per use basis.

None of the other known electronic image management sytems and methods intended to provide an ASP model adequately address the needs of referring physicians and other parties in the healthcare provider stream outside of the imaging clinic.

In one regard, other systems intending to provide a medical image ASP service generally require timely log-on and download procedures at the physician terminal. In another regard, none of the other systems and methods intended to provide a medical image ASP are believed to provide the image center with a history record of where and when images are sent, received, and viewed. However, a system which pushes the images directly to remotely located desktops of interested healthcare providers or patients outside of the imaging clinic would be much more resource efficient at their end. Furthermore, medical imaging centers producing the electronic images would benefit from a system which provides them with a real-time, image history record with easily accessible information about the times and places that each image is sent, received, and viewed at all locations.

Also, other efforts intended to provide a cost-effective ASP generally require costly hardware investment, principally on the part of the respective imaging center, and according to some of these efforts per-use fees are charged for each image viewing occasion. However, smaller imaging clinics and healthcare providers outside of the imaging center would benefit from a business model which provides the associated image work-stations necessary to use the ASP without requiring capital expenditure on the hardware or software. These parties would be greatly benefited by a method that provides a medical image ASP on a monthly service fee only basis, without up-front hardware costs, and without costly "per-use" transaction fees. Moreover, by providing a medical image ASP that charges only the imaging clinics on a fixed fee basis, these centers would be able to solely enjoy the economic benefits of their increased revenues flowing from increased image volume, at least to the extent that such volume is charged through to payers. In particular, the imaging center would benefit from an electronic medical image ASP system that charges only fixed or per use fees, but that provides without direct capital expenditure a local image workstation at the imaging center (including in one aspect a DICOM conversion interface) for interfacing with the remotely located, central management system of the ASP. Other interested healthcare providers and patients outside of the imaging clinic would also greatly benefit from having access to a remote image viewing system for viewing and storing the electronic images available from the ASP, but without requiring them or the imaging center to pay for the viewing system.

SUMMARY OF THE INVENTION

The present invention provides a medical image management system and method that reduces the high financial cost, resource allocation, time, and unreliability associated with conventional production, transportation, and viewing of conventional film-based systems and methods.

The invention in another regard also provides a medical image management system and method that reduces the need for purchasing and/or managing sophisticated technology at medical imaging centers.

The invention also provides a medical image management system that directly addresses the needs of the referring physicians and other healthcare providers located outside of the imaging center and having interest in medical image studies.

The invention also provides a medical image management system and method that integrates diagnostic and other analytical software, algorithms, or other tools associated with medical images within one, central medical image management ASP.

The present invention also provides a medical image management system and method that pushes electronic records containing medical images to healthcare providers outside of the medical imaging center soon after the medical images are taken so that the healthcare providers may view the images without the need to remotely access a central image storage cite and find and download a specific, desired image for viewing.

The invention also provides a medical image management system and method that keeps a medical image history record of times and locations where electronic records containing medical images are pushed to and viewed by parties such as healthcare providers and patients outside of the medical imaging center, and that communicates the medical image history record to the medical imaging center which produces the image.

The invention also provides a medical image management system and method that transmits lossless or substantially lossless medical image records to healthcare providers outside of the medical imaging center without requiring the healthcare provider to spend a significant amount of time to access and view the associated medical images.

Accordingly, one mode of the invention provides a medical image management system that includes a medical imaging system, a local image workstation, and a central data management system. The medical imaging system produces an electronic record in a computer-readable format and that comprises an electronic image associated with a region of a patient's body. The local image workstation communicates with the medical imaging system along a local interface such that the electronic record may be transmitted from the medical imaging device and received by, the local image workstation. The central data management system communicates with the local image workstation along a remote interface such that the electronic record may be transmitted from the local image workstation and received by the central data management system. The central data management system is also configured to push the electronic record to a pre-determined remote viewing system in a format such that the electronic record may be read and the electronic image converted to a recognizable, visible format.

According to one aspect of this mode, at least one of the medical imaging system, the local image workstation, and the central data management system is adapted to transmit the electronic record in a DICOM format. In another regard,

the central data management system is adapted to receive and process the electronic record in a DICOM format.

According to a further aspect, in the event the medical imaging device does not produce the electronic record in a DICOM format, the local image workstation is adapted to convert the non-DICOM electronic record into receives into a DICOM format for transmission to the central data management system.

According to another aspect, the central data management system pushes the electronic record to the remote viewing station in a substantially uncompressed form with respect to the original size. In one more particular variation, the central data management system is adapted to push the electronic record to the remote viewing station without the electronic image being compressed more than about 3 times with respect to the original size. Further to an alternative embodiment, the central data management system pushes the electronic record to the remote viewing station with substantially lossless compression with respect to the original form and size. In another regard, the record is pushed with no loss. In still a further variation, there is at least about 1.5 times compression with respect to the original record size.

According to another aspect of this mode, the remote interface uses the internet. In another aspect, the remote interface uses a digital subscriber line (DSL) interface.

According to another aspect, the medical imaging device may be any one of the following: magnetic resonance imaging devices, CT scanner devices, ultrasound devices, computed tomography devices, nuclear medicine devices, and digital radiography or X-ray devices.

According to another aspect, each one, taken individually, or both of the central data management system and local image workstation have storage systems adapted to store the electronic record.

The system according to this mode may also further include a remote image viewing system that communicates with the central data management system along a second remote interface such that the electronic record is pushed from the central data management system and received by the remote image viewing system. The remote image viewing system may also have its own storage system which is adapted to store the electronic record. This aspect of the system may also further include an image history record system having a remote history record system associated with the remote image viewing system and a central history record system associated with the central data management system. The remote history record system sends a remote system message along the second remote interface to the central history record system and includes information related to at least one of: a time that the electronic record is received at the remote image viewing system, a time that the electronic record is opened at the remote image viewing system, and a time that the electronic image is viewed at the remote image viewing system. This image history record system may also in a further variation include a local history record system associated with the local image workstation, such that the central history record system is adapted to send a central system message along the second interface to the local history record system with at least a portion of the information contained in the remote system message.

According to still a further aspect of this mode, the central data management system comprises an internet-accessible applications service provider (ASP) with an application which is adapted to perform an operation based upon the electronic record that produces a result that is useful in managing the patient's healthcare. In one variation, this application comprises a radiology information system (RIS) that is adapted to store healthcare management-related data with the electronic image as a part of the electronic record. In a further variation, the RIS stores healthcare billing-related information in the electronic record. In another further variation, the RIS stores time-based scheduling-related information associated with the patient's healthcare in the electronic record.

Still another aspect of this mode includes a printer that is adapted to interface with at least one of the medical image system, local image workstation, or central data management system and which is adapted to print a recognizable, visible film associated with the electronic image.

Another mode of the invention provides a medical image management system with a medical imaging means, an image storage means, and an imaging pushing means. The medical imaging means is located at a first location and is for producing an electronic record in a computer-readable format and that includes an electronic image associated with a region of a patient's body. The pushing means pushes the electronic record along a remote interface to a remote image viewing system at a second location that is remote from the first location. Further to this mode, the electronic record is pushed in a format that may be opened such that the electronic image may be converted into a recognizable, visible format.

One aspect of this mode also provides a viewing means associated with the remote image viewing means for viewing the electronic image at the second location. Another aspect also provides means for providing information related to the patient in the electronic record. Yet another aspect provides a DICOM conversion means for converting the electronic record from a non-DICOM format to a DICOM format. Still a further aspect of this mode provides an image history record means for maintaining an image history record related to at least one of the transmission of the electronic record, the receipt of the electronic record, and the viewing of the electronic image. In one regard, this image history record means maintains an image history record related to each of the transmission of the electronic record, the receipt of the electronic record, and the viewing of the electronic image. In one highly beneficial variation, the image history record means includes: means for centrally managing the image history record at a central data management system located at a third location which is remote from the first and second locations; means for communicating the image history record from the central data management system to a local image workstation at the first location; and means associated with the local image workstation at the first location for displaying the image history record.

Another aspect of this mode provides DICOM conversion means for converting the electronic record from the medical imaging means into a DICOM format.

Further to another highly beneficial and desirable aspect of this mode, the image storing means includes a local storage means, a remote storage means, and a central storage means. The local storage stores the electronic record at the first location. The remote storage means stores the electronic record at the second location. The central storage means stores the electronic record at a third location that is associated with a central data management system and that is remote from the first and second locations. In one more detailed variation of this multi-storage aspect, the central storage means comprises a back-up storage means for storing the electronic record at a fourth location that is remote from the first, second, and third locations.

One further aspect of the pushing means according to this mode includes a local pushing means and a central pushing means. The local pushing means is at the first location and pushes the electronic record to a central data management system at a third location which is remote from the first and second locations. The central pushing means is associated with the central data management system at the third location and pushes the electronic record from the third location to the remote image viewing system at the second location.

Another further aspect of the pushing means according to this mode includes a central data management system at a third location that is remote from the first and second locations. The central data management system receives the electronic record from the first location and pushes the record to the remote image viewing system at the second location.

According to still a further aspect of this mode, a display means associated with the remote image viewing system displays the electronic image in a recognizable, visible format at the second location.

Another mode of the invention provides a medical image management system with a local image workstation, a central data management system, and a remote image viewing system, all respectively configured and networked such that the local image workstation pushes the electronic record via the central data management system to the remote image storage system. More specifically, the local image workstation communicates with a medical imaging system along a local interface at a first location. The local image workstation receives an electronic record that includes at least in part an electronic image from the medical imaging system associated with a body of a patient. The central data management system communicates with the local image workstation along a first remote interface from a second location that is remote from the first location, such that the central data management system receives the electronic record from the local image workstation. The remote image viewing system communicates with the central data management system along a second remote interface from a third location that is remote from the first and second locations. The remote image viewing system has a remote image storage system adapted to store the electronic record in a computer readable format, and is adapted to open the electronic record from the remote image storage system and to convert the electronic image into recognizable, visible form.

According to one aspect of this mode, the central data management system has a central image storage system that is adapted to store the electronic record in a computer-readable format. In one further variation, the central image storage system includes a back-tip storage system that is adapted to store the electronic record in a computer-readable format at a fourth location.

In another aspect of this mode, the local image workstation includes a local image storage system that stores the electronic record.

According to another aspect, the system further provides an image history record system associated with at least one of the local image workstation, central data management system, and remote image viewing system. This image history record system maintains an image history record that contains history information related to at least one of locations where the electronic record has been sent, locations where the electronic record has been received, times when the electronic record has been sent to a location, times when the electronic record has been received at a location, times when the electronic record is opened at a location, and times when the electronic image is viewed at a location.

One more variation of this image history record system according to the present mode also provides a remote history record system associated with the remote image viewing system, and a central history record system associated with the central data management system. The remote history record system sends a remote system message from the remote image viewing system to the central history record system and which contains the history information related to activity at the remote image viewing system. The central history record system sends a central system message to the local history record system and which contains at least a portion of the history information contained in the remote system message. In a further more detailed variation the local image workstation is configured to display the history information.

Another mode of the invention is a medical image management system with a medical imaging system, a local image workstation, and means for pushing the electronic image to a remote image viewing, system in a format such that the electronic record may be converted in order to represent the electronic image in a recognizable, visible format.

The medical imaging system produces the electronic record that comprises an electronic image associated with a region of a patient's body in a computer-readable format. The local image work-station communicates with the medical imaging device such that the electronic record may be transmitted from the medical imaging device and received by the local image workstation.

One aspect of the pushing means according to this mode further includes a central data management system, local pushing means for pushing the electronic record from the local image workstation to the central data management system, and remote pushing means for pushing the electronic record from the central data management system to the remote image viewing station.

According to another aspect, the system further includes means for displaying the electronic image at the remote image viewing system.

According to still a further aspect, the system also includes a means associated with the central data management system for processing, the electronic image in order to produce a result that is useful in the patient's healthcare management. This processing means in one highly beneficial variation includes Alzheimer's diagnostic analysis of the electronic image. Another highly beneficial variation includes MR spectroscopy application to the electronic image.

Another mode of the invention provides a medical image management system with a particular central data management system. The central data management system includes a computer which communicates with an electronic transmission means along a first remote interface and electronically receives an electronic record from the electronic transmission means that includes an electronic image associated with a region of a patient's body. The computer also communicates with a remote image viewing system along a second remote interface and pushes the electronic record in a DICOM format to the remote image viewing system.

According to one aspect of this mode, the system also includes a local image workstation that communicates with a medical imaging system that produces the electronic image along a local interface at a first location. The central data management system communicates with the local image workstation along a remote interface from a second location remote from the first location in order to receive the elec-

tronic record from the local image workstation. In one more detailed variation, the local image workstation transmits the electronic record, and the central data management system receives the electronic record, in the DICOM format.

According to another aspect of this mode, the central data management system is associated with an image history record system that maintains an image history record with information related to at least one of: locations where the electronic record has been sent from the central data management system, locations where the electronic record has been received from the central data management system, times when the electronic record has been transmitted from one location to another location, times when the electronic record has been received at one location from another location, times when the electronic record is opened at a location, and times when the electronic image is viewed at a location.

Another aspect of this mode includes a storage system associated with the central data management system and which stores the electronic record in at least two relatively remote locations.

Another mode of the invention is medical image management system with a local image workstation which communicates with a medical imaging system along a local interface in order to electronically receive an electronic record from the medical imaging system that includes an electronic image associated with a region of a patient's body. The local image work-station also communicates with a central data management system along a remote interface in order to push the electronic record to the central data management system. The local image workstation is also adapted to receive and display a message from the central data management system related to an image history record with history information that related to at least one of: locations where the electronic record has been sent from the central data management system, locations where the electronic record has been received from the central data management system, times when the electronic record has been transmitted from one location to another location, times when the electronic record has been received at one location from another location, times when the electronic record is opened at a location, and times when the electronic image is viewed at a location.

Another mode of the invention is a method for managing medical images. The method includes in one regard receiving along a first remote interface an electronic record, which includes an electronic image that is associated with a body of a patient, from a medical imaging system located at a first location and at a central data management system located at a second location that is remote from the first location. The method further includes pushing the electronic record from the central data management system along a second remote interface to a remote image viewing system located at a third location that is remote from the first and second locations.

One aspect of this mode further includes transmitting a central system message from the central data management system and to the local image workstation, wherein the central system message transmitted includes history information that comprises at least one of: locations where the electronic record has been sent from the central data management system, locations where the electronic record has been received from the central data management system, times when the electronic record has been transmitted from one location to another location, times when the electronic record has been received at one location from another location, times when the electronic record is opened at a location, and times when the electronic image is viewed at a location.

Another aspect of this method mode further includes receiving the electronic record at the remote image viewing system and opening the electronic image at the remote image viewing system, wherein the history information comprises the time and location of the receiving and viewing of the electronic image at the remote image viewing system. This aspect also includes communicating the history information from the remote image viewing system and to the central data management system via a remote system message before sending the central history message from the central data management system to the local image workstation.

Still another aspect of this method mode includes applying an application to the electronic image using the central data management system, wherein the application produces a result that is useful in the patient's healthcare management. The method according to this aspect further includes attaching the result to the electronic record to form a supplemented electronic record, and transmitting the supplemented electronic record from the central data management system to at least one of the local image workstation and the remote image viewing system. One particular beneficial variation of this aspect includes using an application that produces a result useful in diagnosing a parameter associated with Alzheimer's Disease. Another variation includes applying an MR spectroscopic analysis of the electronic image.

Another aspect of this mode includes pushing the electronic record from the central data management system to the remote image viewing system in a DICOM format.

Still a further aspect includes pushing the electronic record to the remote image viewing system without substantially compressing the electronic image.

Yet another aspect includes pushing the electronic record to the remote image viewing system after performing substantially loss-less compression to the electronic image.

The systems and methods of the invention for managing medical images electronically over remote interfaces such as via the internet also allow for a highly economical method for providing a medical image management ASP in a manner that expands the bottom line for medical imaging centers in particular. Therefore, the invention also includes various modes associated with the economical cost-flow related to the implementation and use of the medical image management sytems of the invention.

Another specific mode of the invention therefore is a method for providing medical image management system. The method provides a local image workstation that communicates with a medical imaging system managed by a medical imaging center along a local interface at a first location. The local image workstation is configured to receive multiple electronic records from the medical imaging system each comprising at least one electronic image that represents at least a portion of a patient's body. The method also provides a central data management system that communicates with the local image workstation along a remote interface from a second location that is remote from the first location. The method also provides a remote image viewing system that communicates with the central data management system along a second remote interface from a third location that is remote from the first and second locations. Once the local image workstation, central data management system, and remote image viewing systems are installed and interfaced, the method further includes pushing the electronic records from the local image workstation to the remote image viewing system via the central data management system and along the first and second remote interfaces.

Further to this mode, the prior recited steps are performed while charging only the medical imaging center a predetermined, fixed, periodic fee for the pushing of the electronic records through the central data management system regardless of the volume of electronic records pushed per modality. The party responsible for receiving the images at the remote image viewing system is not charged for the viewing system, which is generally downloadable, or for the receipt of the images. The imaging center is not charged for the local image workstation or for the transmission of any given image in a direct way. Regardless of how many images are sent via this system, or to how many places, the imaging center pays the same

One aspect of this mode further includes providing a communication link for the first and second remote interfaces with the central data management system via an IP address associated with the central data management system on the internet.

Another aspect of this mode further includes providing the remote image viewing system at least in part by providing software that is downloadable over the second remote location onto a computer at the third location. In one particularly beneficial variation of this aspect, the software may be downloaded free of charge.

According to another aspect, the local image workstation comprises a computer, and the local image workstation including the computer is provided to the medical imaging clinic for use in the medical image management system without directly charging the medical imaging clinic for the local image workstation.

Still further to another aspect, the method also includes providing a medically useful diagnostic application on the central data management system that is adapted to perform a diagnostic operation on the electronic image at the central data management system to produce a medically useful result, and communicating the result to at least one of the local image workstation or the remote image viewing system in a computer readable form, wherein the result is provided without directly charging the medical imaging clinic or a user operating the remote image viewing system on a per-use basis of the diagnostic application.

An alternative embodiment of the invention provides a polling system located with the remote workstation, viewer or system. The polling system is an automated system within the remote workstation or viewer that polls the central data management system for queued data. The polling system may poll the central data management system on a preset schedule or periodic basis. It may also poll for data upon occurrence of a predetermined triggering event. Such events may, for example be booting the computer, a predetermined log in, establishing or re-establishing an internet connection, detecting a change in an assigned IP address.

The polling system includes: an IP address identifier, IP address notifier, a data request device and an internal poller. The IP address identifier internally determines the connection status and IP address, e.g., assigned by an internet service provider. The IP notifier, after proper authentication, notifies the central database of the current IP address. The data request device requests queued data from the central data management system. The internal poller polls the viewer, workstation or system for the occurrence of a predetermined event that triggers the IP address notification and/or data request.

In variation of this embodiment, the polling system is provided with the image push system that uses push technology as described above. According to this embodiment, the polling system will notify the central data management system of the image system, workstation or remote viewer's IP address. The central data management system will store the last known IP address in its database, for example, in a look up table. When the central data management system receives an image or other data, it will attempt to push the image or other data to the last known IP address of the specified remote location. The central data management system pushes data to locations over the Internet using push technology known to one of ordinary skill in the art, in the unique medical image delivery application and system described above with respect to FIGS. **1–6**. If the delivery fails after a predetermined number of attempts, the data will be placed in a queue in the central data management system with a destination identifier that identifies the intended recipient. The central data management system delivers the queued data to the remote location when the remote module's polling system notifies the central data management system of the its current IP address or when the polling system requests delivery of queued data.

The data delivered by the central data management system may be the image itself or related information, for example, the review history, radiologist or physician notes, text, voice-overs, time, date and person reviewing the images, comments, instructions, as well as other information relating to diagnosis, treatment or the patient's medical record.

Another aspect of the invention provides an internal polling system within the local image station for communicating IP address information to the central data management system. Accordingly, in a similar manner, the local system will update its IP address information and request queued data stored in the central data management system. The central data management system will then send queued data such as information concerning delivery and review status of the delivered medical image, to the local system.

In one embodiment, the polling system within a particular module sends a signal to the central data management system when a particular event has occurred. The signal may either update the IP address and/or request queued data that was not successfully delivered to the module. The event may be, e.g., turning on the system, rebooting the system, connecting to the internet, reconnecting to the internet, internet server IP address reassignment or the expiration of a preset time interval. In this regard, the module's internal software may be structured so that when the module is turned on or booted, the execution program includes sending a signal to the internal poller that an event has occurred. Alternatively, the programming may directly instruct the notification and request device to update the IP address or request queued data from the central data management system. Additionally, the software may be structured to conduct periodic internal polling for changes such as IP address change or loss of Internet connection. For example, the IP address may be identified and stored in a file. Periodically, the stored address will be compared with the current IP address identified to the module to determine if a change has occurred. Such programming may be accomplished by way of computer programming techniques generally known in the art.

The polling event may be the passing of a predetermined time interval. For example, on a periodic basis, the polling system may check the central database for queued data and/or may update the central database's look up table containing IP addresses.

The central data management system tracks delivery attempts and maintains a database of such attempts, suc-

cesses and failures. As described above, the central data management system stores the images and any associated data including delivery and access information, whether originating from a local system, remote system or the central data management system.

The polling system of the present invention provides efficient image delivery to locations or modules that do not have static IP addresses. The system is compatible with more economical, dial-up Internet services. If, for example, an Internet server is designed to switch or change IP addresses during a session, the change in IP address may be updated in the central database.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** shows a schematic overview of the medical image management system of the invention.

FIG. **2** shows a schematic representation of an electronic record having an electronic image and other header information associated therewith which is communicated between remote locations according to the system of FIG. **1**

FIG. **3** shows a perspective view of hardware for the local image workstation used according to the invention.

FIG. **4** shows a schematic representation of the medical image management system of the invention as it interacts via the internet with multiple medical imaging centers and multiple remote parties needed access to images.

FIGS. **5**A–D show various sequential modes of using the system of the invention for managing access, transport, storage, and history records associated with electronic records of medical images according to the invention.

FIG. **6** shows a schematic overview of a beneficial cost-flow associated with using a medical image management ASP system according to the invention

FIG. **7** shows a schematic representation of a method and system for storing, transmitting, receiving and tracking medical images and associated information of an alternative embodiment of the present invention using the polling system of FIG. **10**.

FIG. **8** shows a schematic representation of a method of using the polling system set forth in FIG. **7**.

FIG. **9** shows a schematic representation of the system and method of the embodiment described with respect to FIG. **7** using a polling system illustrated in FIG. **10**.

FIG. **10** shows a schematic representation of a polling system of an alternative embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a medical image management system (**1**) and method that, in one particular beneficial mode using the known "Internet" communications network, functions as an "Applications Service Provider" (ASP), which terms are herein intended to mean an information management service that is centrally accessible from various remote locations. The following are specific embodiments which are contemplated among the benefits associated with the ASP and other aspects of the invention:

1. Electronically deliver medical images in electronic record form to referring physicians, surgeons, radiologists, other healthcare providers, patients, and other interested authorized, parties outside of the imaging center, preferably via "push" technology.

2. Electronically store each image at three separate locations: locally at the imaging center and at two fully redundant, secure, central data centers (and possibly a fourth storage at the remote viewing location).

3. Provide authorized, secure and fast access to the stored image data.

4. Provide special clinical and visualization applications centrally for the benefit of remote users at remote viewing systems.

The present invention will revolutionize the process of image delivery by use of a global broadband network that will connect imaging centers and hospital radiology departments with their radiologists and referring doctors. The invention provides immediate access to patient images, allowing the same diagnostic imaging information to be available at several locations immediately after completion of the procedure. Just as the fax machine completely changed the way doctors received imaging reports, (supplanting the US Postal Service, making the process faster and much more cost efficient), the present invention is believed to represent a similar revolution in the distribution of digital medical images. With the recent advent of broadband Internet connections, which by the end of 2001 will be available to the majority of the population in the form of Digital Subscriber Lines (DSL), continued adoption of this communication mode by the healthcare community will expand the significant transition in the way images are managed between remote locations according to the management system and method of the invention.

According to the invention as shown in FIG. **1**, medical image management system (**1**) includes a medical imaging system (**10**), a local image workstation (**20**), a central data management system (**30**), and a remote image viewing system (**40**), which together provide an efficient, resource-effective, Internet-based ASP for the immediate electronic delivery and storage of medical images. In addition, an image history record system is also provided which allows for efficient tracking of when and where electronic records associated with images are transmitted, opened, and stored.

The overall system (**1**) of the invention is used in one general embodiment according to the following method, which is further shown in finer detail in flow-chart format in FIGS. **5**A–D. A patient study or exam is conducted at a medical imaging center using medical imaging system (**10**) to obtain a set of images associated with a targeted region of a patient's body. These images are provided by the medical imaging system in an electronic form as electronic images (**6**) that are a part of an electronic record (**5**), as shown in FIG. **2** and further explained in detail below. The technologist performing the exam transfers the electronic record to local image workstation (**20**) which is also located onsite at the imaging center. The local image workstation (**20**) is shown in overview in FIG. **3** for the purpose of general illustration. Local image workstation (**20**) archives the data locally, and then "pushes" (as explained in detail below) the electronic record to central data management system (**30**) at a remote location, as described in detail below.

If the imaging system (**10**) does not output the images packaged in the format Digital Imaging and Communications in Medicine (DICOM) compliant format, local image workstation (**20**) will convert the data into the DICOM format prior to transmission to central data management system (**30**) at a remote location with respect to the imaging, center. Once the electronic record (**5**) is received at central data management system (**30**), it is stored at that remote location and automatically routed., again via "push" delivery (described in more detail below), to one or more remote image viewing systems (**40**) at the respective radiologist,

referring physician or surgeon, or other healthcare provider who is at another location remote from both the imaging clinic and the central data management system (30) locations. Where a radiologist is receiving electronic record (5) for viewing and interpretation/diagnosis, the radiologist in one aspect may produce a report containing new information that may be attached to the electronic record (5) and updated to the referring physician or surgeon. In addition, an image history record system (200) maintains an image history record with information regarding transmission and viewing records associated with the electronic record, and routes the respective information in the record back from these remote viewing stations, through the central data management system (30), and to the local image workstation (20) at the imaging center that produced the original image.

More detail of each component of this overall medical image management system as contemplated according to the invention is provided as follows.

Medical Imaging System

As mentioned above, the present invention broadly contemplates use of a medical imaging system (10) that provides images in electronic form for electronic delivery. In particular, the invention is believed to be highly beneficial for providing a useful ASP for managing images associated with studies conducted on MRI and CT medical image systems. In addition, the invention also contemplates the following imaging modalities as suitable substitutes for medical image system for use according to the overall medical image management systems and methods of the invention: ultrasound, computed tomography, nuclear medicine, digital radiography, etc.

Local Image Workstation

Local image workstation (20) is located at the medical imaging center and communicates with a medical imaging system (10) generally onsite at the center's location via a local interface (15). The terms "'local interface" are herein intended to mean interfaces that use locally managed and generally non-publicly accessed and used networks and routers. For the purpose of further illustration, local interfaces according to the intended meaning include without limitation hard-wired direct interfaces, extensions of data paths, and locally routed and/or managed LANs or telecommunication interfaces such as telephone lines that when used according to the invention do not extend beyond a locally and generally privately managed and used router and therefore generally do not use publicly accessed and used telecommunications networks, nodes, or routers.

In one highly beneficial embodiment, local image workstation (20) uses direct capture (as described above) to acquire the electronic image data from the imaging system. This ensures that the exact digital data, as stored on the imaging system, both in terms of matrix size and pixel depth, is transferred to the system of the invention. A physician or other healthcare provider can window and level (control brightness and contrast) as well as zoom and measure pathology with this data set. The physician can also use reference images to know the exact location of the image inside the body. These features are generally not present with frame-grabbed images, which again represents the technique employed by some other known electronic medical image management systems. The other advantage of this direct capture is that the image quality on the receiving end is as good as it is on the shipping end, which means that the image quality is the same as the MRI or CT technologists performing the study sees on the computer.

This contrasts with "secondary" capture methods like video frame-grabbing and film digitization, as described above. Most digital imaging modalities store pixel values as 14 or 16-bit values. The "direct" capture method ensures that the complete 14 or 16-bit information is transferred to the system of the invention. In the case of secondary capture some of the information is lost because the secondary capture technique generally only captures the S-bit analog representation of the image pixel data. Also secondary captured images cannot be manipulated to the same degree. As mentioned above, because of the inherent drawbacks of secondary captured data, the American College of Radiology (ACR) standard states that the direct capture method is preferred for primary diagnosis.

Further, the ACR standard recommends that the DICOM standard be used. Most currently installed medical imaging systems do not output the digital data in the standard DICOM complaint format. Therefore, according to this aspect special interfaces may be required to accomplish "direct" capture by generally converting the non-DICOM record to the DICOM format. Such interface may be provided as a separate DICOM workstation located between the local image workstation (20) and either the medical image system or the central data management system (30) that receives the output from the local image workstation (20). Or, the invention may also incorporate interfaces directly into the local image workstation (20) that enable the direct capture of data generated by many MRI systems, such as by providing a DICOM conversion technology within the architecture of local image workstation (20). One example of such a DICOM-converting interface is commercially available from Image Enhancement System, Inc. (IES), a California corporation, Another example of such an interface is commercially available by MERGE Technologies, located in Milwaukee, Wis. Interfaces to other imaging systems may also be used or otherwise developed and integrated in the overall system and methods of the invention so as to extend the reach of the invention to those imaging systems as well. Interfaces that may be developed for MRI, CT, and other radiological imaging devices are contemplated under the present invention.

It is to be further understood that the present invention contemplates all the benefits of the systems and methods herein described without the need for a local image workstation that is peripheral to the medical imaging system if that imaging system incorporates into its own architecture the necessary communication modes for interfacing and communicating with the other components of the invention as herein shown and described.

Central Data Management System

Central data management system (30) is generally located remotely from the medical imaging center, and communicates with local image workstation (20) via a remote interface (25). Central data management system (30) is also generally located remotely from the remote image viewing systems (40) to where electronic records (5) are to be sent from the central data management system (30). Therefore, central data management system communicates with these remote image viewing systems remotely, for example via remote interface (35) as shown in FIG. 1.

The term "remote" is herein intended to mean sufficient distance away from a location such that interfacing with devices at the location is generally performed in standard course using a remote interface. The terms "remote interface" are herein intended to mean interfaces that use wide area networks (WANs) or other publicly accessed and centrally managed networks or routers such as for example cable networks and publicly accessed telecommunications networks, nodes, and routers. Therefore, in another sense

remote interfaces are communication interfaces that reach beyond local interfaces as described herein. In one highly beneficial mode, the remote interfacing with the central data management system (30) for the push transfer of images to and from that central image management system will employ fast digital lines and flow over the Internet. DSL, cable, ISDN and wireless modalities will also serve as suitable alternatives for remote interface connectivity.

As an internet-based ASP, the central data management system (30) will include collocation and web hosting that may be provided for example by advanced servers such as is commercially available from Exodus. Exodus has managed services using state-of-the-art tools and experience in the key areas of storage performance optimization and security. Servers such as available from StorageTek or the Exodus Network may provide a storage service for data backup and restore solutions. A further architectural aspect of the central data management system (30) may also employ for example the Exodus giga-byte Internet service which offers speed that is 10 times as fast as conventional LANS as well as the Exodus Security Service pack. Services such as provided by Exodus offers 24x7 support, monitoring, redundant Internet access with fiberoptic cable from multiple providers, which eliminates any single point of failure. Physical security, power backup, fire suppression, extensive environmental systems, and mirrored backups at a separate geographic location are all offered by Exodus and may be employed according to the present invention.

The invention contemplates use of collocation facilities, operated by leading providers of such facilities like Exodus Communications, Inc., to house all the storage and computing equipment in particular associated with the central data management system (30). These facilities provide the physical environment necessary to keep the system and service of the invention up and running 24 hours a day, 7 days a week. These facilities are custom designed with raised floors, HVAC temperature control systems with separate cooling zones, and seismically braced racks. They offer a wide range of physical security features, including state-of-the-art smoke detection and fire suppression systems, motion sensors, and 24x7 secured access, as well as video camera surveillance and security breach alarms. Further, these facilities deliver very high levels of reliability through a number of redundant subsystems, such as multiple fiber trunks from multiple sources, fully redundant power on the premises, and multiple backup generators.

It is believed that most other medical image management ASP efforts are intending to use PCs with a Microsoft database on their central servers. It is further believed that such a database will be inadequate in many circumstances, in particular when dealing with the massive storage required by imaging centers and hospitals. For this reason the present invention preferably incorporates more robust database platform, such as for example an Oracle database on a Unix platform. This will ensure a high level of reliability and scalability. The central storage system of the central data management system (30) takes into account the storage and access needs of imaging center and remote users. The rationale behind the architecture is that: most recently stored data is the most frequently accessed data and requires the most expedient retrieval; and as the data ages, the frequency of access and the need for expediency decreases.

The invention's storage system uses a hierarchical storage management (HSM) scheme to exploit the cost/benefit ratios of different storage technologies while realizing an optimum design to satisfy the above rationale. This architecture combines hard disks and tape devices, managed by intelligent software, to leverage the fast access and throughput performance benefits of disks with the cost benefits of tape media. Various aspects of the medical image storage system as provided by the present invention are presented in the following table, showing the different storage media used and the duration for which the data resides on each type of storage device along with approximate costs.

Time	Storage Device	Access Time	Cost/Mbyte
0–30 days	Hard disk RAID	Less than 1 second	25 cents
>30 days	Online tape	1–3 minutes	5 cents

When data is received at the central data management system (30), it is kept on hard disk for 30 days. It is also backed up to the Primary and Secondary archives. After 30 days, the data is moved to tape media. Products like Storagetek's (Storage Technology Corp.) Virtual Storage Manager (VSM) combines hard disk, tape and software to provide high capacity and disk-like performance. By storing older data on slower media and accumulating large quantities of data on cheaper media, the storage model of the invention offers an optimum solution.

The central data management system (30) actively "pushes" the electronic records (5) and associated images (6) to the remote image viewing systems (40) of the radiologists and referring doctors as soon as the images are available. This contrasts with the "pull" model where the images are stored on a server and a user has to login and initiate a download in order to view the images. Such pull-based methods are not believed to adequately address the needs of busy surgeons and physicians who are used to having images on films delivered to them. Therefore, at each of the locations where the images would be needed, the remote image viewing station (40) would be running and available at all times on the Internet in order to achieve immediate "push" delivery of the images as soon as they become available. Similarly, it also assures prompt delivery of a report from the remote User and back through the ASP system to other locations identified. The delivery, may also be scheduled for specific times if the remote image viewing system (40) on the receiving end is known to not be available at all times

Multiple deliver attempts will also be made. The acceptance of the unique mode of constant connectivity, however, will grow considering the aggressive expansion of fast, always on Internet Connections.

Further aspects of using IP addresses over the Internet to assist the routing of electronic records (5) to and from various facilities via the central data management system is provided in FIG. 4. Further to this Figure, the central data management system's Internet Protocol (IP) address is generally designated as "IP-C", whereas electronic record origination addresses (local image workstations) are designated variously as IP#1A, IP#2A, etc., and destination IP addresses where the records are to be pushed are designated generally as IP#1B, IP#2B, etc. Accordingly, IP#1A pushes an electronic record (5) to central data management system (30) via its IP address IP-C, which pushes the record (5) to the desired remote image viewing systems (40) found over the internet at address IP#1B. All the desired destination addresses, including the central data management system (30) and the locations for the remote image viewing systems (40), may be designated in the header (7) associated with the electronic record (5), and may be placed there for example by manual or automated forms of entry to the record via the respective local image workstation (20).

FIG. 4 also shows electronic records (5) via flow arrows pointing in each of two opposite directions. This is intended to represent both forward and reverse flow of information related to the records (5), such as returning updated versions of the records (5) with new diagnostic information flowing from the remote image viewing system user according to various of the particular embodiments herein described and shown in the Figures. In particular, interpreting physicians, payers, and other parties outside of the medical imaging center and representing the remote image viewing systems of the invention will often attach reports to the electronic record for others to see, including the medical imaging center itself and other physicians. This is represented by the reverse flow of electronic record (5) as shown in FIG. 4, and the respective reports, etc., are shown schematically in FIG. 2 as new information (7') which is attached to the "header" or "data" section of electronic record (5) along side of the electronic image (6).

Moreover, to the extent one party with a first remote image viewing system desires to send and image to another party with a second remote image viewing system, that may be accomplished directly from the first remote image viewing system. This is shown in FIG. 1 by way of arrows between system (40) and system (40') that represents that other second remote system, which may be another physician, a patient, a third party payer, or any other authorized party. In another aspect, however, for the purpose of more centralized control, such party-to-party transfer may also require routing through the central data management system (30), and may even in some circumstances require pre-authorization via the local image workstation (20) that originally brought a given electronic record into the system.

In addition to the above mentioned "push" delivery service, a web-based "'pull" functionality will also be available to facilitate secure data access by authorized individuals from locations other than the normal delivery locations. Consistent with privacy requirements, a physician will have access to records of only those patients for whom he or she is responsible or otherwise authorized.

In contrast to other known efforts at providing a medical image management ASP, the present invention employs "push" delivery of medical images directly to the referring physician's office or offices, which may be completed according to the invention immediately after generating the image at the medical imaging center. The use of the push methodology directly addresses the needs of referring physicians prescribe the imaging study in order to diagnose or treat a patient. Clearly, these healthcare providers want the images delivered to their office(s) just as they have the films delivered today. With push delivery of electronic image records according to the invention, the image delivery will take place in the background and be on the physician's desktop computer ready for review whenever the doctor is ready to view them.

The push aspect of the invention saves costs directly equated with physician time, and is also believed to enable an increase in imaging center revenues. In one regard, referring physicians do not need to spend the time to log on to find and download the images, and in another regard medical imaging clinics that use the medical image management systems and methods of the invention will be able to use the connectivity of the overall system as a marketing advantage, attracting referring doctors and their patients who can participate in the "push" image transmission stream.

Further, the communications bandwidth requirements for speed are less stringent with the present invention's "push" model because the data transfer occurs in the background, shortly after the study is completed, and before the doctor desires to view them.

Remote Image Viewing System

In order to display and manipulate the received images, the invention in one aspect includes remote image viewing system (40) that all radiologists and referring doctors must use in conjunction with the image delivery service of the invention. The remote image viewing system in one beneficial embodiment is a software program that may be downloaded from the website associated with the central data management system (30), and run on any PC that satisfies certain minimum requirements. This program may also be available on CD ROM for distribution to doctors and/or image center users of the invention. The remote image viewing system (40) preferably gives the physician the ability to change display formats, window and level the image (adjust the brightness and contrast), magnify the image, manipulate the grayscale, measure the anatomy and pathology, easily identify spatial locations, and to the extent there is direct-capture and lossless transmission make exact measurements and determine the location of abnormalities for surgical planning.

In one further embodiment, only images delivered according to the invention will be viewable through this viewer. However, in another aspect images delivered according to the invention may be made viewable through any DICOM conformant receiver/viewer.

The remote image viewing system (40) is how physicians and other users outside of the imaging center will "experience" images transported according to the invention, and thus the system (40) Must be provided in a form that is well accepted by the medical community in particular. In a further aspect beneficial to healthcare providers, payers, and patient's alike, this viewer may be used, free of charge, to view and analyze images transported according to the invention, as further developed below.

Remote image viewing system (40) also preferably incorporates or interfaces with a database. This database in one beneficial mode is an extensive, queriable database so the physician can simply type in the patient's name or other identifying factors to bring up that particular patient immediately, even if there are hundreds of patients on the doctor's hard drive. The physicians will also be able to configure their patient image database on their computer in different ways in order to organize their patients the way they feel will be most efficient for them.

This flexibility differentiates the present invention from other medical image management ASPs that will only allow central storage of images at the company site. With the present invention, the image data, once the physician selects the patient, will be immediately downloaded into RAM on his or her computer. This allows the physician to have access quickly to the entire data set and allow for rapid change from image to image efficiently, thereby decreasing the time that the physician needs to review his patients' images. The physician will be able to view his or her patients' images even if the computer is off-line, such as when the doctor carries the laptop computer on rounds, or even to the operating room, All other known medical image management systems and methods are believed to require the physician to log on to web sites and then download the images to his computer. Hence, with other ASP systems not associated with the present invention, if the physician wishes to see his patients' images again, he must repeat the extensive and lengthy login and download procedures. It is believed that such methods which rely upon the physician to

actively login and download, will be unacceptable for the referring doctors who are extremely busy and are used to images being delivered to them on film. Doctors will expect the same (image delivery to the doctor, not the doctor having, to actively seek their patient images) in the future with any digital image ASP.

The referring physicians and other users of the invention will be strongly encouraged to use DSL for interfacing the remote image viewing system (**40**) with the central data management system (**30**) of the invention since this provides for fastest and economical Internet access. Moreover, it is preferred that the Internet connection between the central data management system (**30**) and the remote viewing system be continuously online in order to best facilitate the "push" delivery aspect of the invention. The ability to maintain the continuous connectivity desired will improve with the ongoing, aggressive expansion of fast, always on Digital Internet Connections.

Notwithstanding the significant benefits of the electronic image flow as herein shown and described, some parties will still invariably want medical images on hard-copy film. This may also be accomplished by use of the present system as shown in FIG. **1** by sending the electronic record to a film printer (**50**) that converts the electronic image of electronic record (**5**) into film image (**5'**) for delivery to the interested party. Because the image is stored and managed centrally, film printers that exist locally to the intended delivery location may be sent the electronic record via remote interface, and may in fact even have themselves a remote image viewing system according to the invention, at least to the extent that it is configured to open the proprietary electronic records to access the film for printing.

Diagnostic & Workflow Tracking ASP Operations

The ASP aspect of the invention also allows for specific clinical and workflow operations to be performed on the electronic image at the central image management system in a centralized and controlled environment to the benefit of all remote users of the ASP. This is shown schematically for the purpose of illustration at ASP tool (**32**).

In one particular embodiment, the invention provides special algorithms for processing, and analyzing images such as MRI images, such as for example in order to diagnose various conditions associated with the processed image. In one particular aspect for the purpose of further, illustration, at least one processor or software-related algorithm may be applied to the centrally stored image information in order to diagnose and stage Alzheimer's Disease. Further more detailed examples of Alzheimer-diagnostic analysis that may be offered under the ASP model of the present invention are described in the following references:

1) Meyerhoff, D. J., MacKay, S., Constans, J-M., Norman, D., VanDyke, C., Fein, G., and Weiner, M. W.: Axonal loss and membrane alterations in Alzheimer's disease suggested by in vivo proton magnetic resonance spectroscopic imaging. Annals of Neurology 36:40–47, 1994.

2) Constans, J. M., Meyerhoff, D. J., Gerson, J MacKay, S., Norman, D., Fein, G., and Weiner, M. W.: ^{1}H magnetic resonance spectroscopic imaging of white matter signal hyperintensities: Alzheimer's disease and ischemic vascular dementia. Radiology 197:517–523, 1995.

3) Constans, J. M., Meyerhoff, D. J., Norman, D., Fein, G., and Weiner, M. W.: ^{1}H and ^{31}P magnetic resonance spectroscopic imaging of white matter signal hyperintensities in elderly subjects. Neuroradiology 37:615–623), 1995.

4) MacKay, S., Ezekiel, F., Di Sclafani, V., Meyerhoff, D. J., Gerson, J., Norman, D., Fein, G., and Weiner, M. W.: Alzheimer disease and subcortical ischemic vascular dementia: Evaluation by combining MR imaging segmentation and H-1 MR spectroscopic imaging. Radiology 198:537–545, 1996.

5) MacKay, S., Meyerhoff, D. J., Constans, J. M., Norman, D., Fein, G., and Weiner, M. W.: Regional grey and white matter metabolite differences in Alzheimer's disease, subcortical ischemic vascular dementia and elderly controls with ^{1}H magnetic resonance spectroscopic imaging. Archives of Neurology 53:167–174, 1996.

6) Tanabe, J. L., Amend, D., Schuff, N., Di Sclafani, V., Ezekiel, F., Norman, D., Fein, G., and Weiner, M. W.: Tissue segmentation of the brain in Alzheimer's disease. American Journal of Neuroradiology 18:115–123, 1997.

7) Schuff, N., Amend, D., Ezekiel, F., Steinman, S. K., Tanabe, J., Norman, D., Jagust, W., Kramer, J. H., Mastrianni, J. A., Fein, G., and Weiner, M. W.: Changes of hippocampal n-acetyl aspartate and volume in Alzheimer's disease: A proton MR spectroscopic imaging and MRI study. Neurology 49: 1513–21, 1997.

8) Schuff, N., Amend, D., Meyerhoff, D. J., Tanabe, J., Norman, D., Fein, G., and Weiner, M. W.: Alzheimer's disease: Quantitative H-1 MR spectroscopic imaging of fronto-parietal brain. Radiology 207:91–102, 1998.

9) Schuff, N., Vermathen, P., Maudsley, A. A., and Weiner, M. W.: Proton magnetic resonance spectroscopic imaging in neurodegenerative diseases. Current Science Journal 6:800–807, 1999.

10) Tanabe, J., Ezekiel, F., Schuff, N., Reed, B., Norman, D., Jagust, W., Weiner, M. W., Chui, H., and Fein, G.: Magnetization transfer ratios of white matter hyperintensities in subjects with subcortical ischemic vascular dementia. Am J Neuroradiol 20:839–844, 1999.

11) Kwan, L. T., Reed, B. R., Eberling, J. L., Schuff, N., Tanabe, J., Norman, D., Weiner, J., and Jagust, W. J.: Effects of subcortical cerebral infarction on cortical glucose metabolism and cognitive function. Arch. Neurology 56:809–14, 1999.

12) Schuff, N., Amend, D., Knowlton, R., Tanabe, J., Norman, D., Fein, G., and Weiner, M. W.: Age-related metabolite changes and volume loss in hippocampus by proton MR spectroscopic imaging and MRI neurobiology of aging. Neurobiology of Aging 20: 279–285, 1999.

13) Capizzano, A. A., Schuff, N., Amend, D., Tanabe, J., Norman, D., Maudsley, A. A., Jagust, W., Chui, H., Fein, G., and Weiner, M. W.: Subcortical ischemic vascular dementia: Assessment with quantitive MRI and ^{1}H MRSI. American Journal of Neuroradiology, (In Press 2000).

The disclosures of these references are herein incorporated in their entirety by reference thereto.

Other image processing tools such as M.R. Spectroscopy (or "Proton MRS"), may also provide an ASP tool (**32**) for use with the invention. Proton MRS uses the MRI scanner to listen for the radiowaves of major normal proton containing brain biochemical metabolites (myoinositol, choline, creatine, amino acids, n-acetyl aspartate) as well listening for the radiowaves of abnormal proton containing metabolites (lipid and lactate). The added metabolic bio-chemical information impacts on the differential diagnosis of abnormal lesions seen on the anatomic MRI as being either infection, tumor or stroke all of which have different treatment regiments. In certain cases proton MRS can prevent invasive neurosurgical biopsy (so called MRS brain biopsy). Proton MRS may have a future role in the early clinical evaluation process and response to therapy in dementia such as Alzheimer's Disease. Proton MRS has its own separate CPT billing code and can be performed in 5 to 20 minutes,

depending on the complexity of the clinical question. Further more detailed examples of an MR Spectroscopy operation that is believed to be well suited for use under the ASP aspect of the invention is described in the following references:

1. Boyko O B, Spielman D. Clinical Applications of MR Spectroscopy. Proceedings Seventh Annual Educational Course International Society for Magnetic Resonance In Medicine, Syllabus (1999) Pages 109–119.
2. Boyko O B. Neuroimaging and Proton Spectroscopy in CNS Neoplasms. In Stark D D and Bradley W G (eds.) Magnetic Resonance Imaging, Mosby 1999.
3. Boyko O B. MR Spectroscopy of the Brain. In Tindall G (ed.) Practice of Neurosurgery, JB Saunders New York 1996.
4. Lazeyras F, Charles H C, Tupler L A, Erickson R, Boyko O B, Krishnan K R R. Metabolic Brain Mapping In Alzheimer's Disease using Proton Magnetic Resonance Spectroscopy. Psychiatry Research 82:95,1998.
5. Ross B, Michaelis T. Clinical Applications of Magnetic Resonance Spectroscopy. Magnetic Resonance Quarterly 10: 191,1994.

The disclosure of these references are herein incorporated in their entirety by reference thereto.

Such ASP-based diagnostic/image processing allows medical imaging centers using the invention to offer the respective service to a second tier of users doing business with that first doctor/user, such as for example offering the service to referring physicians, patients, and healthcare providers such as third-party payer/insurance companies. Also, the imaging center does not have to make an upfront investment in software, computer work stations and additional clinical staff—rather, the service is supplied at the central data management system (**30**) according to the associated ASP service. Additionally, the invention allows the owner or supplier of the diagnostic tool to reach many more patients than may be possible by creating separate, individual centers for local access and used, removing the need for example for creating a high number of localized, individual Alzheimer diagnostic centers across the country and world. The return on investment in these applications may be difficult to justify for healthcare providers such as imaging centers, radiologists, or referring physicians if such individual practice centers were required to purchase the individual applications, particularly when they are to be used in relatively rare clinical instances. Nevertheless, the applications themselves may be crucial in those specific clinical instances. Therefore, such applications when layered on top of the present invention's ASP platform will make them instantly available to a large medical community without the associated cost of ownership. As medicine becomes more complex patients will better served clinically and economically served through access to leading experts in ultra specialized procedures via the internet ASP of the present invention. Moreover, highly specialized analytical tools of the type herein disclosed can be performed with more skill, reliability and efficiency and at lower costs through the ASP aspect of the invention than under the more conventional, localized access/use modes.

The invention also contemplates ASP tool (**32**) as providing certain workflow software, generally referred to as "Radiology Information Systems" (RIS), for integrating the storage and communication of images with certain workflow software. RIS systems electronically attach critical patient management information (such as patient records, fee billing, and history, prior diagnosis and treatment history, etc.) to images and are generally known to provide high level, detailed workflow management capability to make radiology operations more efficient in the areas of scheduling patients, staffing, asset management, etc. The radiology community has accepted this approach, but only the largest hospitals have purchased the necessary software and hardware, due to the prohibitive cost of individual ownership. Generally speaking, known RIS technology has much higher capacity for information flow and management than individual medical imaging, centers require. Therefore, according to the RIS/ASP mode of the invention, wherever the image goes through the system of the invention, the associated patient care information also goes too—all in one integrated electronic file, and without any individual healthcare provider needing to actually purchase the RIS system. Again, by hosting this type of application as an ASP, wider and faster adaptation will result with revenue flow managed through one central site according to the various charging structures described above.

The RIS system as ASP tool (**32**) may be entirely managed through internet aspect to the ASP service on the central data management system (**30**), or it may have various components layered over the central data management system (**30**) in addition to the remote image viewing system (**40**) and/or the local image workstation (**20**), as shown at remote ASP interface (**42**) and local ASP interface (**22**). In particular these local and remote ASP interfaces (**22, 42**) may require resident architecture at the respective local image workstation (**20**) and remote image viewing system (**40**) in order to perform their role in the overall flow of information as relates to ASP-based activities on those terminal.

Image Storage System

Medical images are archived according to the invention in multiple locations according to a storage system (**100**) as follows.

All diagnostic studies are "medical records" and must be stored for a considerable period of time, generally for a minimum of seven years. The present invention provides a more efficient and less expensive solution for image storage, based on the Internet-based paradigm for the distribution and storage of medical images. More specifically, the invention utilizes a three-prong approach to the storage of the digital images: 1) at the remote image viewing systems (**40**) generally at the referring doctors' and radiologists' practice locations; 2) at two central servers associated with central data management system (**30**), and 3) at the local image workstations (**20**) located at transmitting imaging centers or hospitals. Therefore, there will be four redundant, physically separate locations where the images are stored to ensure unsurpassed reliability and efficiency in accessing image data.

The first storage location is at a local image workstation (**20**) at the imaging center's or hospital's own radiology department, in a DICOM format, according to a local storage system (**120**). This local access will make healthcare providers that use the invention feel extremely comfortable knowing that they have access to their data directly, without needing to seek permission from a third party to access their own data. A central storage system (**130**) associated with central data management system (**30**) stores all electronic records (**5**) at two central back-up sites (**30', 30"**) that, are separated by considerable geographic distance. The medical imaging center and the referring doctors will have extensive access to the electronic records stored on the central backups (**30'30"**). A remote storing system (**140**) stores the electronic records (**5**) on the remote image viewing systems (**40**) at as many remote locations as the respective users wish—this

allows these users, in particular referring physicians and/or radiologists, to view the images at any of a number of locations that he generally frequents in performance of his work (e.g. different office sites, hospital, etc.).

Image History Record System

The invention according to another embodiment also provides for information associated with the transport, storage, viewing, analysis, and other management of a medical image to be efficiently communicated to all interested parties, herein referred to and shown in the Figures as image history record system (200)(FIGS. 1 and 5A–D).

In one aspect, medical image centers can track the entire process of image deliver storage and review from the local image workstation (20) merely by reference to the local image workstation (20) located in their respective clinic or hospital. More specifically, a local history record system (220) displays the image history on the local image workstation (20)'s monitor, and for example notifies the clinic of each successful delivery. Also, if a delivery attempt was unsuccessful (for instance the referring doctor's computer was turned off or the Internet access was down), the customer is notified so appropriate actions can be taken to assure a quick delivery. Thus healthcare providers using the system have a degree of image management that has never been possible before with film. Furthermore, when and where the images are reviewed by the radiologist or referring physician a message may be reflected on the local image workstation (20). None of the other medical image management features with their ASP.

More specifically, remote image viewing system (40) according to one beneficial embodiment operates as follows. A remote history record system (240) associated with a remote image viewing system (40) sends a remote message (235) containing information about transmission, receipt, and viewing of the record to the central data management system (30). A central history record system (230) associated with the central data management system (30) in turn sends a central message (225) including the information from the remote message (235) to the local image workstation (20). Accordingly, all image history is updated to the imaging clinic and is accessible for review and display there, real-time, via a local history record system (220) associated with the local image workstation (20).

This image history record system (200) and associated real-time access to image transmission and use information is believed to be particularly useful when associated with the "push"-based image transmission method of the invention. Because the images are pushed to various remote locations, the message feedback methods as described is important to ensure proper management by the imaging center, and so that that practice knows what is happening to the records they have produced and subsequently distributed through the ASP of the invention.

Associated Billing, Methods

Costs associated with healthcare services such as medical imaging are highly scrutinized, and economics of imaging services are directly related to widespread availability. Beneficially, the systems and methods of the invention provide for a method of cost-flow associated with the use of the medical imaging ASP that is believed to directly address such economics in order to compel rapid adoption, in particular by free-standing medical imaging clinics that are highly sensitive in particular to up-front fees and large capital expenditures. The cost-flow method of the invention will consist of an activation fee with each clinic, that may be for example approximately $10,000 which is believed to cover all of the expenses to install the local image workstation (20) in the clinic as well as applications training expenses for both the customer and for a certain set number of referring doctors. For initial customers already having DICOM interfaces, this $10,000 fee will be waived. Since these customers already have the required hardware for electronic image transport and storage as contemplated herein, the cost to start service to these customers will be minimal. These customers will be separated geographically and the first 50–100 customers will be targeted in major cities, so that the initial users will be selected geographically from throughout the United States. This provides the widest exposure throughout the country for rapid adoption.

One cost-flow embodiment of the invention charges a fixed monthly fee, in addition to waiving installation costs in certain DICOM enabled imaging centers. This is believed to be beneficial to imaging centers or small hospitals that would have to pay $100–300 thousand up front for a PACS type system and also would need extensive IT personnel support to keep the PACS operating. The cost of using the system of the invention according to this cost-flow method is less than the cost of just the IT person who would be needed for a PACS. Moreover, PACS systems do not address the issue most important to the imaging centers: delivering the images to the referring doctors quickly and reliably. In addition, the present invention does not require the cost for secondary capture equipment and a DICOM sending station that other known medical image ASP services are believed to require. Picture Archiving and Communication Systems (PACS) generally cost $60,000 to $1,000,000, and include associated inefficiencies and costs of additional personnel to run the sophisticated hardware. According, to this invention, a monthly fee, for example of approximately $4,000 or $48,000 annually, may be charged for high performance electronic delivery, storage, retrieval, and display of the digital images. In one embodiment, this is the only fee charged, independent of volume of use. According to another embodiment, a per use fee may also be charged. In either case, the ASP-related fees represent a considerable cost savings to the clinic or hospital when compared to either use of a PACS or the current use of film. The invention therefore helps imaging centers and hospital radiology departments maximize their productivity while minimizing their costs.

Still further, the mode of charging/paying for these services is simplified under the ASP model of the invention. Rather than manufacturing and selling individual workstations or software packages to each localized physician/user, under the present invention much fewer (and possibly only one) analytical tool may be created that is thus shared by each remote user of the ASP, resulting in either a "per use" or "periodic" fee structure that does not require any one, large sum payment.

FIGS. 8 and 10 illustrate a polling system of an Alternative Embodiment. FIGS. 7 and 9 illustrate a variation of the present invention in which the medical image management system includes at least one polling system 400 as illustrated in FIG. 10. FIG. 9 illustrates a medical image management system similar to the system illustrated in FIG. 1 with like numerals representing the same elements with the corresponding description herein. The system of FIG. 9 additionally includes a polling system 400 located with each of the local image workstation 20 the remote image viewing systems 40. The polling systems 400 each communicate with the central data management system 330. The central data management system 330 further includes a delivery queue 231 that holds data for which attempted delivery has failed. Each set of data queued for delivery in the data queue 231

includes an identifier that associates the particular set of data with the intended delivery location. The identifier may also associate that data with its origin and/or its corresponding location in the central storage system **130**. The central data management system **330** also comprises a look up table **232** that stores the last known IP address for each local or remote workstation, viewer or system. Finally, the central data management system **330** includes a delivery status database **233** that tracks the delivery status of all data including information relating to delivery attempts, successes and failures. In an alternative arrangement, this information may be stored with the data itself.

As illustrated in FIG. **10**, the polling system **400** includes a connection status monitor **401** that tracks the Internet connection status of the module and identifies and stores the most recent IP address in an associated file. The connection status monitor **401** may also monitor the on/off status of the module, e.g., whether the module has connected to the Internet. The polling system **400** also includes an IP notifier/data requester **402** that notifies the central data management system **330** of the current IP address and/or connection status of the module. Alternatively or in addition, the IP notifier/data requestor **402** requests queued data located in the central data management system **330** as described in more detail below. The polling system **400** further comprises an internal poller **403** that checks the connection status and signals to the IP notifier/data requester **402** when an event has occurred. Such event may be, for example, booting the computer, establishing an Internet connection, a change in the IP address and/or the passing of a predetermined time interval.

Either the internal poller **403** or the connection status monitor **401** may signal to the IP notifier/data requester **402** to request queued data from the delivery queue **231** in the central data management system **330** and/or provide the look up table **232** with updated IP address information. The central data management system may be not arranged to track IP addresses or to utilizing push technology. In such a case, the IP notifier/data requestor **402** may serve simply to poll the database for data.

The internal poller **403** signals to the IP notifier/data requester **402** at the end of predetermined intervals. The internal poller **403** may also request connection status information from the connection status monitor **401** at predetermined intervals. The internal poller **403** may ask the connection status monitor **401** whether a new connection has been made. It may also ask whether the IP address has been changed. The connection status monitor **401** may also be programmed signal to the internal poller **403** when the connection status has changed. In the event that a new connection has been made or the IP address has been changed, the internal poller **403** may instruct the IP notifier/data requestor **402** to send a signal the central data management system **330**, requesting queued data and/or updating the IP address stored in the central data management system **330**.

Alternatively, the connection status monitor **401** may be arranged to signal to the IP notifier/data requestor **402** when the on/off connection status or IP address of the module has changed. According to this embodiment, in the event that a new connection has been made or the IP address has been changed, the connection status monitor **401** directly instructs the IP notifier/data requestor **402** to send a signal the central data management system **330**, requesting queued data and/or updating the IP address stored in the central data management system **330**.

In either case, the connection status monitor **401** provides the updated IP address to the IP notifier/data requester 402 either directly or by way of the internal poller **403**.

In use, the central data management system **330**, just as the central data management system **30** previously described herein, receives and stores data in the central storage system **130** and the secondary systems **30'** and **30"**. The data may comprise, for example, an image from a local image workstation, associated patient information, review history from remote or local sites, radiologist or physician notes, text, voiceovers, comment, remote or local history records, diagnostic, treatment or other information relating to a patient's medical record. The data is also stored in the data queue **231** as illustrated in FIG. **7** (**301**).

The data is then pushed or delivered to the destination(s) based on information in a look-up-table **232** where the look up table **232** contains a last known IP address associated with each location **302**. Push technology where information is sent to a predetermined address, is generally known in the art.

The remote module **40** then provides a confirmation as to whether or not delivery is completed **303**. (The preferred embodiment is described with respect to the remote module **40**, although the module at the delivery destination may be a local or remote workstation, image viewer or other interface.) If delivery is complete, the delivery status database **233** and the central history file record are updated to indicate delivery status as completed, including the time of delivery (**304**). The delivered data file is then removed from the queue **231**.

If the delivery is not successful, then the delivery status database **233** is updated to indicate delivery failure (**305**). The central data management system **330** then waits until IP notifier/data requester **402** of the remote module **40** requests queued data (**306**) and/or updates the IP address in the look up table **232**. When the request is received, that data is delivered to the IP address in the updated look up table **232** (**307**). This cycle is repeated until there is a successful delivery. As part of the delivery status database **233**, certain files that are not delivered by a certain time may be brought to the attention of a system administrator, preferably of the data origin.

FIG. **8** illustrates the use of the polling system **400** described with respect to FIGS. **7–10** in use with the remote module or workstation **40**. The remote module **40** establishes an Internet connection (**310**). The remote module **40** connects to the central data management system **330** (**311**). In this regard, the connection between the remote module **40** and the central data management system **330** may be established, for example, by way of a static or dedicated IP address, a floating IP address, or as otherwise provided by an Internet service. The remote module **40** checks its IP address by way of software within the connection status monitor **401** that monitors the connection status and determines the module's IP address (**312**). The steps described are not necessarily performed in this order. For example, they may be reversed.

After determining the remote module's IP address, the IP address look up table **232** of the central data management system is updated **313**. This may be accomplished a number of ways. In preferred embodiments, the connection status monitor device **401** provides the updated IP address information to the IP notifier/data requestor **402** either directly or indirectly through the internal poller **403**. Through internal software, the IP notifier/data requester **402** sends a signal to the look up table **232** with updated IP address information.

The local module then requests any data that may have been stored in the delivery queue **231** (for example, while the local module was offline) (**314**). The request is made by the IP notifier/data requestor **402** that has been instructed

either by the connection status monitor **401** or the internal poller **403** to request queued data as described above.

If queued data is present **(315)**, the data is delivered from the delivery queue **233** by way of the updated IP address stored in the look up table **232**. Alternatively, if the central data management system does not have an IP address look-up table for the purpose of data deliver, the IP address from which the data request is sent, will be used to deliver the data. The data is accepted by the remote module **40 (316)**. Then the remote module **40** waits for an event **(317)**. If data is not present, **(315)**, the remote module **40** continues to wait for an event **(317)**. The poll event may be, for example, the end of a preset interval of time, and/or another event such as booting, rebooting, connecting to Internet, reconnecting to the Internet, or detecting a reassigned IP session number.

If the push system is being used, while waiting for the poll event, any data received by the central data management system that is to be delivered to this module may be pushed to the module in a manner such as that described above.

When a poll event has occurred such as the end of a poll interval, the system checks the IP connection status **(318)**. If the status has not changed, then the system awaits requests queued data and continues from **314**. Alternatively, when the push system is used, because the connection status has not changed and the IP address located in the look-up table is the current IP address, the system instead of requesting queued data, may just continue to wait for the next polling event, i.e., return to **317** and the central data management system will send the data as it is received.

If the status has changed **(319)**, and there is no internet connection **(320)**, then the module is instructed to reestablish an internet connection (returning to **310**). If there is an internet connection, **(320)** then the software instructs the connection status monitor to check to see if there is a connection with the central data management system **330 (321)**. If there is no connection to the central data management system then the software instructs the system to make a connection to the central data management system, returning to step **311**. If there is a database connection, then the software instructs the connection status monitor **401** to determine if the IP address has changed **(322)**. If the IP address has changed, then the a signal is sent to the central data management system **330** to update the look up table **232** with the new IP address the cycle continues at step **313**. If the IP address has not changed, there is a request for queued data and the cycle continues from step **314**.

The invention described above may take various forms or may be accomplished in a variety of manners. The polling system may comprise numerous software and or hardware configurations that will accomplish the described invention and are contemplated to be within the scope of the invention. The polling system may be used alone or in conjunction with a push system as described above. Other events may trigger the poll request depending on the configuration or specific needs of the viewing system (remote or local).

What is claimed is:

1. A medical image management system comprising:

a central data management system which is adapted to receive and store an electronic record from a medical imaging device; and

a remote image viewing system arranged to receive the electronic record and to display the record in a visible format, said central data management system and said remote image viewing system being in communication along a remote interface;

wherein said central data management system is configured to push the electronic record to the remote image viewing system and to store the electronic record in a queue if the central data management system fails to push the electronic record; and

wherein said remote image viewing system comprises a polling system including an internal poller to identify when an event has occurred, and a data requestor in communication with said central data management system to request queued data when said event has occurred.

2. The system of claim **1** wherein said event is a booting of the remote image viewing system.

3. The system of claim **1** wherein said event is establishing an internet connection.

4. The system of claim **1** wherein said event is a change in IP address.

5. The system of claim **1** wherein said event is the expiration of a predetermined time interval.

6. The system of claim **1**, wherein the remote interface comprises a publicly accessed telecommunication interface.

7. The system of claim **1** wherein the remote interface comprises the internet.

8. The system of claim **1**

wherein said central data management system further comprises an IP address look up table including a last known IP address associated with a remote image viewing system;

wherein said central data management system is configured to push the electronic record to the remote image viewing system at said last known IP address; and

wherein said polling system of the remote image viewing system further comprises an IP address notifier in communication with said central data management system to notify said central data management system of the current IP address of the remote image viewing system when said event has occurred.

9. The system of claim **1** further comprising

a second image system arranged to receive the electronic record and to display the record in a visible format, said central data management system and said second image viewing system being in communication along a remote interface;

said second image system further arranged to receive information relating to said electronic record;

wherein said central data management system is configured to push the electronic record to the second image system and to store the electronic record in a queue if the central data management system fails to push the electronic record; and

wherein said second image system comprises a polling system including an internal poller to identify when an event has occurred, and a data requestor in communication with said central data management system to request queued data when said event has occurred.

10. The system of claim **9** wherein said central data management system is configured to push the information relating to the electronic record to the second image system and to store the information relating to the electronic record in a queue if the central data management system fails to push the electronic record.

11. The system of claim **10** wherein said information relating to said electronic record comprises at least one of, a review history, radiologist notes, physician notes, text, voice-overs, time, date and person reviewing images, comments, instructions, information relating to diagnosis, information relating to treatment of a patient, and information relating to a patient's medical record.

12. The system of claim 10, wherein said second image system comprises a local image workstation,

wherein said system further comprises an image history record system associated with at least one of the central data management system and local image workstation, and which is adapted to maintain an image history record that comprises said information relating to the electronic record which comprises at least one of: locations where the electronic record has been sent, locations where the electronic record has been received, times where the electronic record has been sent to a location, times when the electronic record has been received at location, times where the electronic record is opened at a location, and times where the electronic image is viewed at a location.

13. The system of claim 12 further comprising an image history record system associated with the remote image viewing system; and

a central history record system associated with the central data management system,

wherein the remote history record system is adapted to send a remote system message from the remote image viewing system to the central history record system, which remote system message contains the history information related to activity at the remote image viewing system, and wherein the central history record system is adapted to push a central system message to the local history record system, which central system message contains at least a portion of the history information contained in the remote system message.

14. A medical image management system comprising:

a central data management system which is adapted to receive and store an electronic record from a medical imaging device; and

a remote image viewing system arranged to receive the electronic record and to display the record in a visible format, said central data management system and said remote image viewing system communicating along a remote interface;

wherein said central data management system comprises an IP address look up table including a last known IP address associated with a remote image viewing system and wherein said central data management system is configured to push the electronic record to the remote image viewing system at said last known IP address and

wherein said remote image viewing system comprises a polling system including a internal poller to identify when an event has occurred and an IP address notifier in communication with said central data management system to notify said central data management system of the current IP address of the remote image viewing system when said event has occurred.

15. The medical image management system of claim 14 wherein said event is the booting of the remote image viewing system.

16. The medical image management system of claim 14 wherein said event is establishing an internet connection.

17. The medical image management system of claim 14 wherein said event is a change in IP address.

18. The system of claim 14 wherein said event is the expiration of a predetermined time interval.

19. The system of claim 14, wherein the remote interface comprises a publicly accessed telecommunication interface.

20. The system of claim 14 wherein the remote interface comprises the internet.

21. The system of claim 20 wherein said information relating to said electronic record comprises at least one of, a review history, radiologist notes, physician notes, text, voice-overs, time, date and person reviewing images, comments, instructions, information relating to diagnosis, information relating to treatment of a patient, and information relating to a patient's medical record.

22. The system of claim 20 wherein said second image system comprises a local image workstation, and wherein said system further comprising an image history record system associated with at least one of the central data management system and local image workstation, and which is adapted to maintain an image history record that comprises said information relating to the electronic record which comprises at least one of: locations where the electronic record has been sent, locations where the electronic record has been received, times where the electronic record has been sent to a location, times when the electronic record has been received at location, times where the electronic record is opened at a location, and times where the electronic image is viewed at a location.

23. The system of claim 20 further comprising an image history record system associated with the remote image viewing system; and

a central history record system associated with the central data management system,

wherein the remote history record system is adapted to push a remote system message from the remote image viewing system to the central history record system, which remote system message contains the history information related to activity at the remote image viewing system, and wherein the central history record system is adapted to push a central system message to the local history record system, which central system message contains at least a portion of the history information contained in the remote system message.

24. The system of claim 14 further comprising

a second image system arranged to receive the electronic record and to display the record in a visible format, said central data management system and said second image viewing system being in communication along a remote interface;

said second image system further arranged to receive information relating to said electronic record;

wherein said central data management system is configured to push the electronic record to the second image system and to store the electronic record in a queue if the central data management system fails to push the electronic record; and

wherein said second image system comprises a polling system including an internal poller to identify when an event has occurred, and a data requestor in communication with said central data management system to request queued data when said event has occurred;

wherein said central data management system comprises an IP address look up table including a last known IP address associated with the second image system and wherein said central data management system is configured to push the information relating to the electronic record to the second image system at said last known IP address associated with the second image system, and

wherein said the second image system polling system further comprises an IP address notification device in communication with said central data management system to notify said central data management system of the current IP address of the second image system when said event has occurred.

25. The system of claim 24 wherein said central data management system is configured to push the information relating to the electronic record to the second image system and to store the information relating to the electronic record in a queue if the central data management system fails to push the electronic record.

26. A medical image management system comprising:

a medical imaging means at a first location for producing an electronic record in a computer-readable format and that includes an electronic image associated with a region of a patient's body;

a storage means for storing the electronic record;

a pushing means for pushing the electronic record along a remote interface to a remote image viewing system at a second location that is remote from the first location, wherein the electronic record is pushed in a format that may be opened such that the electronic image may be converted into a recognizable, visible format;

a queue means for temporarily storing an electronic record when it has not been successfully pushed to the remote image viewing system; and

a polling means at said remote image viewing system for requesting an electronic record stored in said queue means when a predetermined event has occurred.

27. A medical image management system comprising:

a medical imaging means at a first location for producing an electronic record in a computer-readable format and that includes an electronic image associated with a region of a patient's body;

a storage means for storing the electronic record;

a pushing means for pushing the electronic record along a remote interface to a remote image viewing system at a second location that is remote from the first location, wherein the electronic record is pushed in a format that may be opened such that the electronic image may be converted into a recognizable, visible format;

an IP address look up means for storing a most recent know IP address corresponding to a remote image viewing system;

a polling means at said remote image viewing system for updating the IP address look up means when a predetermined event has occurred.

28. A method for managing medical images, comprising:

receiving along a first remote interface at a central data management system, an electronic record from a medical imaging system located at a first location, wherein the central data management system is located at a second location that is remote from the first location, and wherein the electronic record includes an electronic image that is associated with a body of a patient; and

pushing the electronic record along a second remote interface to a remote image viewing system located at a third location that is remote from the first and second locations;

storing an electronic record in a temporary location when the electronic record has not been successfully pushed;

requesting the temporarily stored electronic record by the remote image viewing system upon the occurrence of a predetermined event.

29. The method of claim 28 further comprising

adding information to the electronic record at the remote image viewing system to create a revised electronic record;

pushing the revised electronic record to a local image workstation located at said first location;

storing the revised electronic record in a temporary location when the revised electronic record has not been successfully pushed to said local image workstation;

requesting the temporarily stored electronic record by the local image workstation system upon the occurrence of a predetermined event.

30. The method of claim 28 wherein said information added to the electronic record comprises at least one of, a review history, radiologist notes, physician notes, text, voice-overs, time, date and person reviewing images, comments, instructions, information relating to diagnosis, information relating to treatment of a patient, and information relating to a patient's medical record.

31. A method for managing medical images, comprising:

storing the IP address of a remote location in a look up table in a central data management system at a second location;

receiving along a first remote interface at the central data management system, an electronic record from a medical imaging system located at a first location, wherein the central data management system is located at the second location that is remote from the first location, and wherein the electronic record includes an electronic image that is associated with a body of a patient; and

pushing the electronic record from the central data management system along a second remote interface to a remote image viewing system located at the remote location that is remote from the first and second locations;

checking the IP address at the remote image viewing system upon the occurrence of a predetermined event and if the IP address has changed, communicating the changed IP address to the central data management system; and

updating the look up table with the changed IP address.

32. The method of claim 31 further comprising adding information to the electronic record at the remote image viewing system to create a revised electronic record;

pushing the revised electronic record to a local image workstation at the first location;

checking the IP address at the local image workstation system upon the occurrence of a predetermined event and if the IP address has changed, communicating the changed IP address to the central data management system; and

updating the look up table with the changed IP address.

33. The method of claim 32 wherein said information added to the electronic record comprises at least one of, a review history, radiologist notes, physician notes, text, voice-overs, time, date and person reviewing images, comments, instructions, information relating to diagnosis, information relating to treatment of a patient, and information relating to a patient's medical record.

34. A medical image management system comprising:

a central data system which is adapted to receive and store an electronic record from a medical imaging device;

a remote image viewing system arranged to receive the electronic record; and

a remote interface between said central data system and said remote image viewing system, wherein said central data system and said remote image viewing system are in communication along said interface,

said remote image viewing system including a polling system comprising an internal poller to identify when an event has occurred and a data requestor in communication with said central data management system to request queued data when said event has occurred.

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